Devoted to
TEXTILE
CHEMISTRY
BLEACHING
DYEING
PRINTING
FINISHING

SEPTEMBER 22, 1947
VOLUME 36, NO. 18

AMERICAN DYESTUFF REPORTER

SEP 29

Yellow+Blue=White?

For years bleachers have been creating successfully the illusion of white on cotton, rayon and linen by this method. However, a yellowish ground plus blue does not make white as revealed when comparisons of such "whites" are made with those produced with Tinopal B V A*.

While Tinopal B V A is applied like a dyestuff, actually color is not imparted to the fibre but rather is there created (though not obviously) a fluorescence which intensifies the white beyond any process or product available before the origin of Tinopal B V A.

You must see the results—Bluing vs. Tinopal B V A—to appreciate the amazing advances made in Whites with the use of Tinopal B V A.

**Patent applied for*

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In Great Britain
The Geigy Co., Ltd.
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Dyestuff Makers Since 1859

OFFICIAL PUBLICATION
of the
PROCEEDINGS
AMERICAN ASSOCIATION
OF TEXTILE CHEMISTS
AND COLORISTS

THIS

AERO BRAND STEARATES

STORY SPEAKS FOR ITSELF!

AERO* BRAND STEARATES . . . Calcium . . . Zinc . . . Aluminum . . . Magnesium . . . are products of the finest manufacturing facilities of their kind. The famous AERO BRAND seal on your stearate supplies means a fine, fluffy texture, uniformity and other recognized superior processing characteristics contributing basic advantages to the efficiency and economy of your operations. For product quality . . . for service . . . for the all-around dependability on which economical operations rely . . . it's CYANAMID AERO BRAND STEARATES.

CYANAMID'S MODERN FACILITIES BECOME YOUR DEPENDABLE SOURCE OF SUPPLY WHEN YOU SPECIFY . . .

AERO BRAND STEARATES

Industrial Chemicals Division

AMERICAN CYANAMID COMPANY

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*Trade Mark

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AMIOCA

100% AMYLOYPECTIN STARCH

UNIQUE IN

- PASTE AND FILM PROPERTIES: Clear, Cohesive, Non-jelling, Non-skinning, Highly Viscous, Adhesive
- ABILITY OF PASTES TO RECOVER ORIGINAL PROPERTIES AFTER FREEZING
- EASE OF CONVERSION BY AMYLOLYTIC ENZYMES
- REMOISTENING PROPERTIES OF ITS DRIED FILMS
- COMMERCIALLY AVAILABLE IN LARGE QUANTITIES

AGAIN AVAILABLE: AMIOCA is the new commercial starch obtained from domestically bred waxy maize. The unique properties of pure AMIOCA and its modifications — *as successfully developed by National Starch Products* — should be studied by the food, paper and textile fields. These properties should be compared with tapioca, potato and other tuber starches; and with natural gums such as arabic, tragacanth, karaya and other thickeners.

DESCRIPTION: AMIOCA is unique among starches because it consists entirely of amyloypectin. It is generally believed to be a more or less branched or non-linear polymer of glucose. Its molecules, being highly hydrated and unable to readily associate, give rise to highly viscous, clear, cohesive pastes free from any tendency to thicken or jell on ageing.

Other commercial starches such as corn, tapioca, wheat, potato, etc., contain two components — usually 20-30% amylose in addition to amyloypectin. Amylose is believed to be a linear or straight chain polymer of glucose. In pastes, its molecules tend to associate with each other and with the amyloypectin molecules. This tendency leads to thickening, jelling and increased opacity.

AMIOCA comes as a white powder or in pearl form resembling ordinary corn starch. It gelatinizes sharply, starting at 70°C and proceeding over a range of only 8°C. It has a peak hot viscosity of approximately 4,000 centipoises in 20 parts of water; and 15,000 centipoises in 10 parts of water. AMIOCA modifications range from materials which require from 20 or more parts of water to those requiring less than 1 part of water at a comparable viscosity.

POSSIBLE APPLICATIONS: AMIOCA and AMIOCA modifications offer *textile sizings* which are non-jelling with good adhesive and film forming properties and with excellent rinsability . . . *textile finishes* with clear, glossy films, and resistance to iron-browning . . . *grease-proof tub sizings* with non-jelling properties that permit high solids application . . . *paper beater sizings* that are non-jelling and permit a high degree of hydration . . . *paper coatings* with higher solids and greater binding power at a given viscosity . . . *foods* with modified jelling properties, clarity and freedom from cereal taste . . . *frozen foods* with ability to recover their original properties after defrosting . . . *drum dried or dehydrated* foods with better stability and clarity.

WE'RE READY to match our research and laboratory efforts with yours in further exploration of Amioca starch applications to your products. Address: National Starch Products, Research and Development Labs., 270 Madison Avenue, New York City. Plants: Dunellen, N. J., Chicago, Indianapolis and San Francisco. In Canada: Meredith, Simmons & Co., Ltd., Toronto and Montreal. In Holland: Nationale Zetmeelindustrie, N. V. Veendam.

National STARCH PRODUCTS

STARCHES — AND SPECIALTIES WITH EASILY DEMONSTRATED SUPERIORITY

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AMIOCA

100% AMYLOYPECTIN STARCH

UNIQUE IN

- PASTE AND FILM PROPERTIES: Clear, Cohesive, Non-jelling, Non-skinning, Highly Viscous, Adhesive
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Ever name triplets?

Monsanto had to recently . . . and it wasn't easy. You see, Monsanto's unique new textile chemical, Resloom . . . introduced first to make *rayons crush-resistant* . . . now has a wonderful, new "sister" application: *making woolens washable*. And soon to be offered are equally remarkable improvements for cottons. In brief, Resloom is the *basic* product; there are three variations in formula to do three different jobs.

The question arose: Should there be one name for all three of these applications . . . or three names, one each for each special function? There were good arguments for either choice.

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1	**RESLOOM**—Formula R for Crush-Resistant Rayon
2	**RESLOOM**—Formula W for Washable Woolen
3	**RESLOOM**—Formula C for Wrinkle-Resistant Cotton

Resloom, therefore, will mean generally . . . *lasting character and greater performance* to wool, cotton, rayon. And it will mean special properties for each major type of fiber, as indicated. Obviously, in blended fabrics Resloom will improve every part.

Monsanto is certain that this simplifying decision will work out to the greatest advantage for all concerned. You are invited to investigate any or all of these Resloom formulations for *your* products. Monsanto has an ambitious program of promotion for the months ahead . . . take advantage of it by taking advantage of Resloom . . . for crush-resistant rayons, washable woolens, wrinkle-resistant cottons. Address: MONSANTO CHEMICAL COMPANY, Textile Chemicals Department, 140 Federal St., Boston 10, Mass.

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Velvamine GF is a blend of amines and softeners designed to protect acetate colors from gas or fume fading. It resists removal by drycleaning and, when used on mixed fabrics, has a minimum effect on the shade and light fastness of the direct colors. Velvamine GF produces a soft, full hand and does not affect the appearance of the treated fabrics.

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A white powder soluble in water at 80° F. Capable of dispersing iron, calcium and magnesium salts and redissolving or re-dispersing precipitated compounds of these metals. It is so highly buffered that the pH of its solution is practically independent of its concentration.

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CLARENCE E. MOSS, 19 Wilson Ave., Rumford (16) R. I.

Canadian Selling Agents: Carbic Color and Chemical Co., Inc., 56 McNab Street South, Hamilton, Ontario

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OR

POWDERED

Houghton has both in its Cerfak line

And both are "tops"—real proven money values—unexcelled for scouring textile fibers and fabrics.

There's a CERFAK ready for your use, whether it be

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or any similar applications of wet processing. When you need a material for scouring, here's a choice of synthetic detergents which can't be beat. Write us for recommendations.

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IN EITHER CASE YOU ELECT A WINNER FOR SCOURING WOOLEN PIECE GOODS

Experience doubtless influences your choice of the type of product used in your mill for scouring woolen piece goods. Your preference may be for soap . . . or it may be for synthetic detergents.

But whichever you prefer, you can count on excellent performance with Olate or Orvus. The proven advantages of these two products listed below will tell you why.

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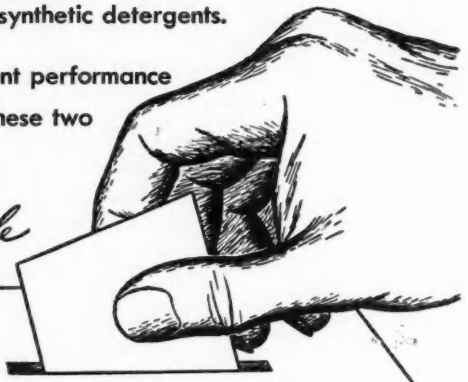


Olate

A pure, neutral flaked soap of exceptionally low titer and gentle cleansing action.

Fast dissolving.

Fluid solutions penetrate fibers quickly and evenly.

Excellent emulsifying, and scouring and lubricating properties.

Fast rinsing.

Provides excellent protection against uneven shrinkage and minimizes harshness and stickiness.

Retains its efficiency in low temperature processing.

ORVUS*

A neutral synthetic detergent with an enviable record for safety.

Fast, thorough wetting, emulsifying and scouring action.

Guards against streaks and spots resulting from hard water soap deposits.

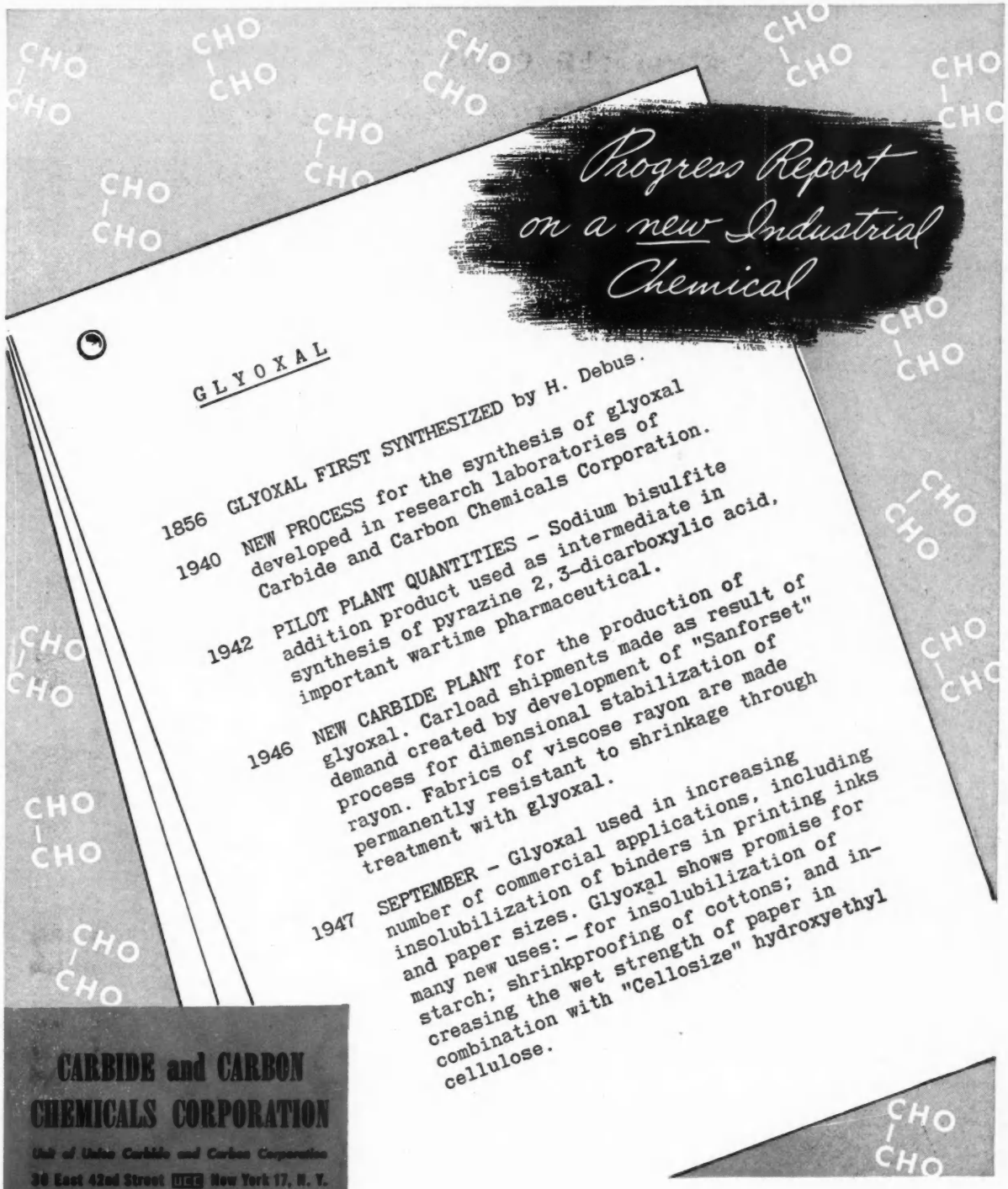
Works equally well in acid or alkaline baths.

Safe to fiber, fabric and color.

Promotes uniform, level dyeing.

Prevents development of undesirable odors and yellowing of goods in storage.

***Discuss your Orvus requirements with your Procter & Gamble salesman.**


Progress Report
on a new Industrial
Chemical
GLYOXAL
1856 GLYOXAL FIRST SYNTHESIZED by H. Debus.
1940 NEW PROCESS for the synthesis of glyoxal developed in research laboratories of Carbide and Carbon Chemicals Corporation.
1942 PILOT PLANT QUANTITIES - Sodium bisulfite addition product used as intermediate in synthesis of pyrazine 2,3-dicarboxylic acid, important wartime pharmaceutical.
1946 NEW CARBIDE PLANT for the production of glyoxal. Carload shipments made as result of demand created by development of "Sanforset" process for dimensional stabilization of rayon. Fabrics of viscose rayon are made permanently resistant to shrinkage through treatment with glyoxal.
1947 SEPTEMBER - Glyoxal used in increasing number of commercial applications, including insolubilization of binders in printing inks and paper sizes. Glyoxal shows promise for many new uses: - for insolubilization of starch; shrinkproofing of cottons; and increasing the wet strength of paper in combination with "Cellosize" hydroxyethyl cellulose.
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Offices in Principal Cities

In Canada:

Carbide and Carbon Chemicals, Limited, Toronto

MORE INFORMATION: If you would like technical data on glyoxal—write for Form 5654—please address Department "A".

"Cellosize" is a registered trade-mark of Carbide and Carbon Chemicals Corporation

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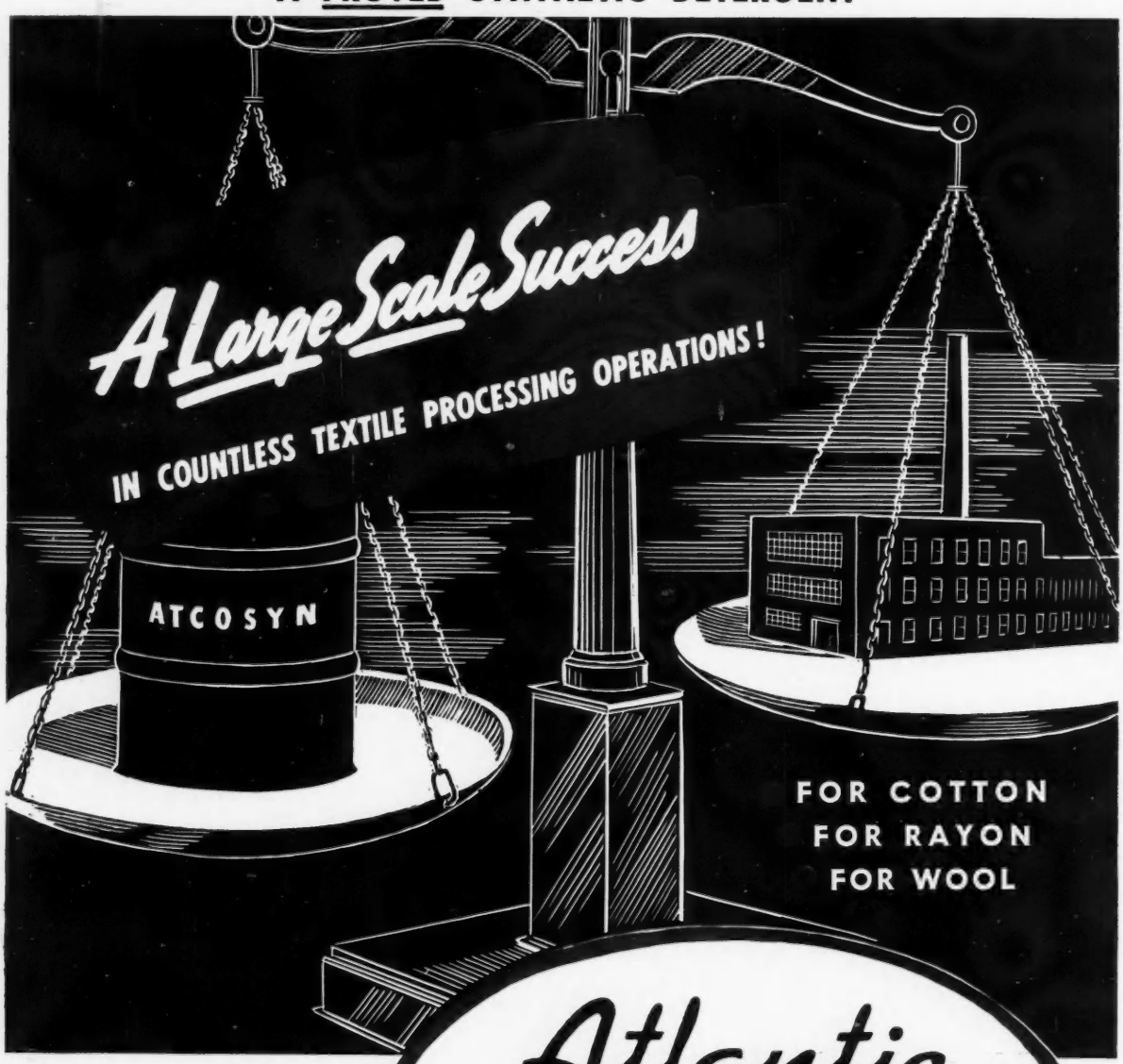
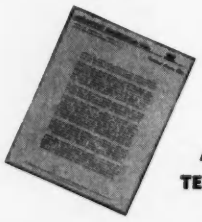
A PROVED SYNTHETIC DETERGENT





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Atlantic Chemical Co., Inc.

MAIN PLANT: CENTREDALE, RHODE ISLAND
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for printing bright, fast colors
on cotton, rayon and linen at low cost

- bright clear colors
- wide color range
- excellent fastness to washing
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- readily soluble
- quick ageing
- easily applied
- available in powder and solution form
- can be printed alongside indanthrenes and algosols
- combine quality with economy

we will be glad to furnish formulas and technical data

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Wherever You Want PERMANENT Drapability

...on Rayon, Bemberg or Cotton

Cation-active softening with Onyxsan LG gives unusually effective drapability to cotton, rayon and bemberg fabrics which lasts for the life of the goods. On other textiles the effect is similar, with most satisfactory resistance to washing.

The Onyxsan family of cation-active softening agents has made finishing history in the past ten years with the wide variety of durable hands offered, ranging from a smooth, waxy touch to the utmost in soft drapability. These finishes bring about a characteristic change *within* the yarn, completely different from the superficial effects of surface lubrication.

Let us know what kind of hand you want. There's an Onyxsan to meet your requirements!

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- Stable to hard water, chlorides, sulfates and organic acids.
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- Easy to apply in the jig, pad, quetsch, dye beck, etc.
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For Plain or Dischargeable Dyeing of Acetate Rayon

EASTONE RED R is a highly soluble product suitable for dyeing medium bright shades of red on cellulose acetate rayon. Over a wide temperature range, level shades of substantially the same depth are produced in either jig or box dyeing.

Eastone Red R is being used extensively either as a self-shade or in combination with other dyestuffs which have drawing and absorption power adaptable to the type of dyeing work that is employed. Its excellent fastness to sublimation adapts it to application printing. Eastone Red R is especially recommended as the red component in shades which are to be used for discharge printing of acetate rayon fabrics.

This dye is one of an ever-expanding line of Eastman Acetate Dyestuffs . . . all are available in a wide color range. For information concerning these dyestuffs, address your request to TENNESSEE EASTMAN CORPORATION (Subsidiary of Eastman Kodak Co.), KINGSPORT, TENN.

Eastman

ACETATE DYESTUFFS

The CHICAGO CONVENTION ISSUE
American Dyestuff Reporter
will be published October 20th

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Copies will be flown to Chicago
for distribution to members
of the A.A.T.C.C. and others attending

☆

ALL ADVERTISING COPY MUST
BE IN OUR HANDS BEFORE
OCTOBER FIRST

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A full page black and white advertisement at a cost of $160.00 will bring your product or service to the attention of more than 8,000 technicians who are the all important factors in the purchasing of wet-processing products and equipment.

We suggest that you reserve your space immediately.

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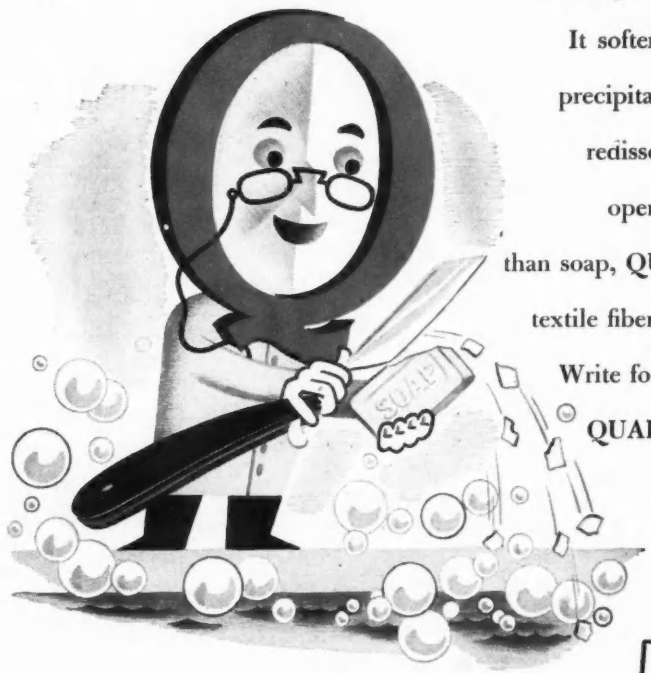
Wherever you use soap in textile wet processing, you can cut soap consumption 25% to 50% with easy-to-use QUADRAFOS. At the same time, you'll notice marked improvement in detergency . . . This greater washing power with less soap comes from three properties of QUADRAFOS. It softens even the hardest water without precipitation . . . conditions the goods . . . redissolves any lime soap formed in previous operations or introduced with the goods . . . Milder than soap, QUADRAFOS will not harm the most delicate textile fibers . . . can be added dry to many operations. Write for more information about the way QUADRAFOS can help you reduce costs and improve quality in practically every processing step. Use the coupon below.



softens water without precipitation...deflocculates ...redissolves precipitates...promotes free rinsing

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- ☐ Raw wool scouring
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- ☐ Viscosity control of printing pastes

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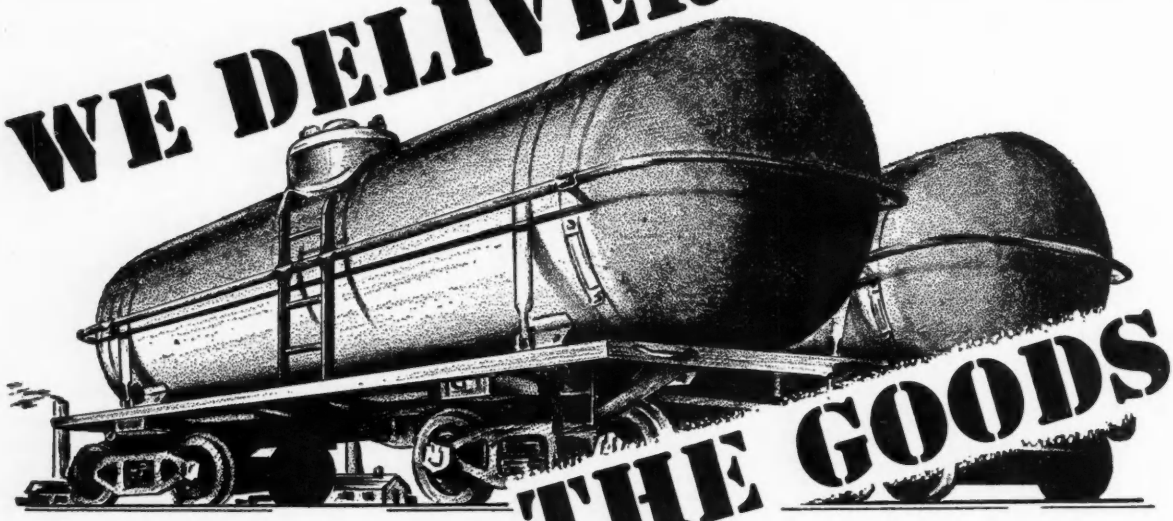

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For enhanced lustre—

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In all fabric, warp and skein mercerizing

LUMERCINE causes instantaneous wetting out, even penetration of the caustic when used in concentrated caustic solutions. The result is a smooth round surface and an enhanced lustre. Lumercine quickly penetrates tightly woven and heavy weight fabrics, leaving the fibres open and swelled for uniform dyeing and level shades. Because it dissolves immediately and completely in mercerizing baths, Lumercine makes no scum, does not cause sludge in caustic recovery systems.

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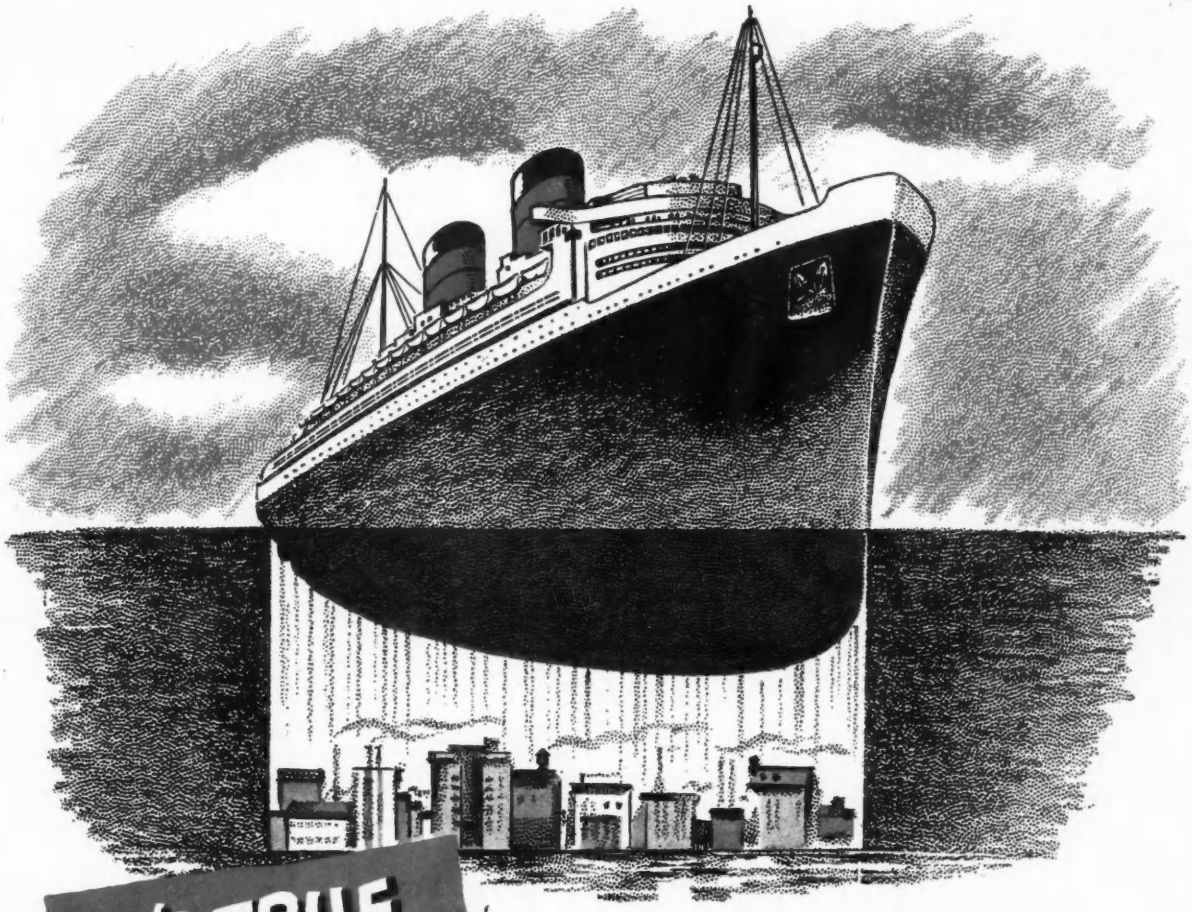

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September 22, 1947
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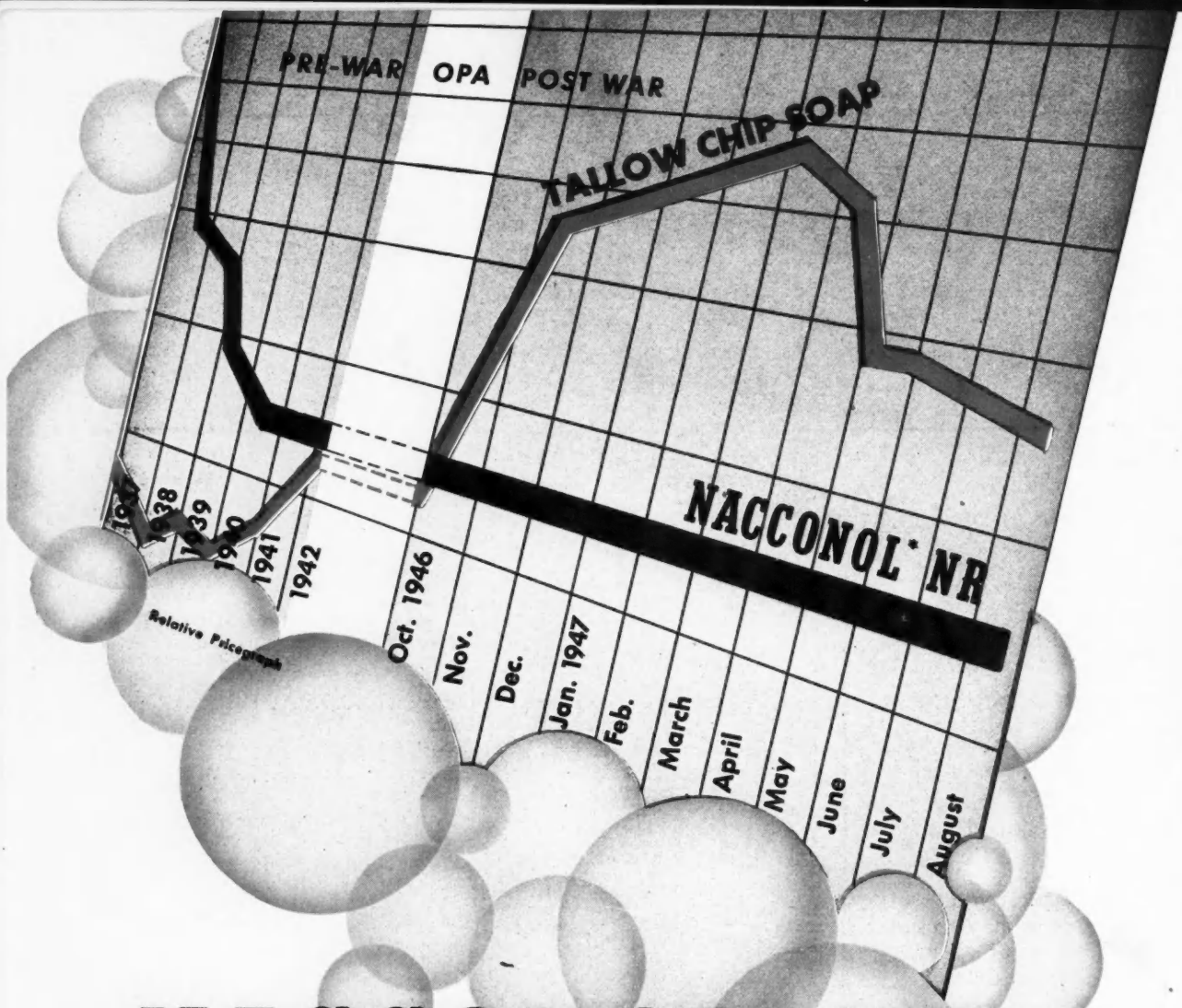

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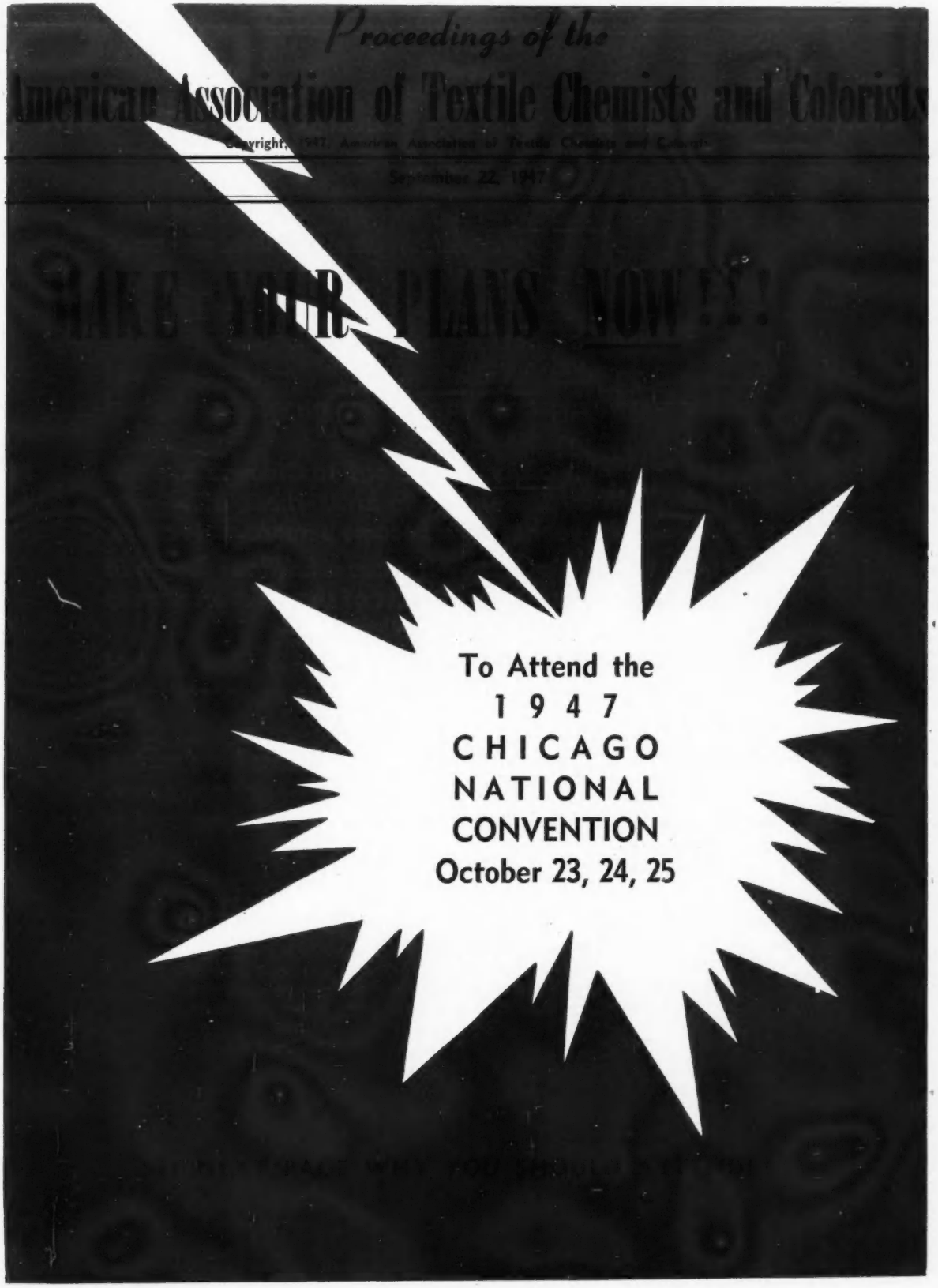

Proceedings of the
American Association of Textile Chemists and Colorists
September 22, 1947
To Attend the
1 9 4 7
CHICAGO
NATIONAL
CONVENTION
October 23, 24, 25

Why YOU should attend the Chicago Convention....

1. *You owe it to yourself—read the program printed elsewhere in this issue and you will be convinced that you can't afford to miss this convention.*
2. *You owe it to your employer—show the program to him and it will convince him that you should be there.*
3. *You owe it to your association—only by such national meetings can we meet one another to promote our mutual interests.*
4. *You owe it to your officers—get out to Chicago to meet them (they will be there), get to know them, offer your cooperation—let your officers become persons, not names.*
5. *You owe it to your industry—it faces a brilliant future of great developments—keep abreast of these developments by attending the national convention.*
6. *You owe it to the Mid-West Section—they have worked long and diligently to give you a convention that will amply repay you for your attendance.*
7. *You owe it to the speakers—your committees have spared no efforts to provide the best in the field—each and everyone has an important message—important to you and to your employer.*

Your Association needs ACTIVE participating members—not passive ones. One of the most important objects of the Association is to "establish channels by which the interchange of knowledge . . . may be increased." One of the most important of these channels is your national convention—to meet the members from other sections, to get to know them and their problems.

If you have never attended a national convention—make this the first!

To you others: Don't miss this one!

Show this message to your employer and act NOW!

KENNETH H. BARNARD
National Chairman

Program of Events for Chicago Convention Nearing Completion

AL J. FEIT
Chairman, Mid West Section

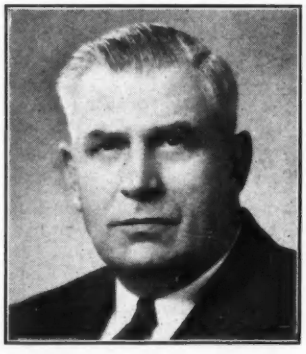
A PRELIMINARY program and information sheet for the 1947 Convention to be held under the auspices of the Mid-West Section at the Congress Hotel on October 23, 24 and 25 has recently been mailed. The official program will be distributed at the Registration Desk of the Convention and will also appear in the October 20th issue of the REPORTER.

Enclosed with the program was a registration card and registration envelope. It was emphasized that complete information be given and instructions followed carefully so that your badge and ticket will be ready for you at the registration desk when you arrive. Also enclosed was a post card so that hotel reservations could be made.

For the purpose of introducing members to prospective employers the Personnel Service will operate, without charge, from Thursday afternoon through Saturday morning. Complete information regarding this service appears elsewhere in this issue.

The Alumni Luncheon will be continued this year, following the practice inaugurated at the Silver Jubilee Convention, and will be held on Saturday, October 25th at 12:30 P.M.

A ladies registration headquarters and reception parlor will be maintained adjacent to the general registration room. A number of special events have been planned for the ladies including a conducted sight seeing or shopping tour on Thursday afternoon. Tickets for a breakfast club radio program will be available for Friday morning and on Friday afternoon there will be a tour of the Marshall Field Department Store followed by a luncheon and style show. On Saturday a number of points of interest are recommended including the Chicago Art Institute, the Adler Planetarium, the Field Museum and the Museum of Science and industry.



ELMER F. SMITH
General Chairman

The Florentine Room on the 3rd floor of the Congress Hotel will house several instructive and attractive exhibits of modern accomplishments in the textile field. Exhibitors have been requested to stress technical advances in their showings, as it is the desire of the Association that this comparatively new convention feature be maintained on a high plane. There will also be a large exhibit of the AATCC Research Committee.

Program of Events

The following is a preliminary program of events:

THURSDAY, OCTOBER 23, 1947:

9:00 A.M. to 7:00 P.M. *Registration*—English Walnut Room.

10:00 A.M. to 12 Noon. *Exhibits are open*—Florentine Room.

10:30 A.M. to 12 Noon. *National Council Meeting*—Parliament Room.

1:00 P.M. to 5:30 P.M. *Research Committee Meeting*—Pine Room.

2:00 P.M. to 5:00 P.M. *Personnel Service*—French Room.

7:30 P.M. *Dinner Honoring Corporate and Charter Members*—Casino Room.
Address—"Gearing Toward Better Textiles"—J. Robert Bonnar, General Dyestuff Corp., Chairman AATCC Executive Committee on Research.
Address—"An Industrialist's Patent Policies"—Harry A. Toulmin, Jr., Patent Attorney.

FRIDAY, OCTOBER 24, 1947:

9:00 A.M. to 6. P.M.—*Registration*—Francis I Room.

9:00 A.M. to 12 Noon. *Personal Service*—French Room.

2:00 P. M. to 5:00 P.M.—*Personnel Service*—French Room.

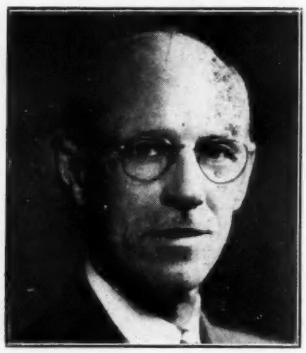
9:30 A.M. to 12 Noon. *General Technical Session*—Gold Room.
Miles A. Dahlen, Presiding.
"The Textile Drying Process"—Albert C. Walker, Bell Telephone Laboratories.
"Plastic Materials that Supplement or Supplant Textiles"—C. W. Patton, Bakelite Corp.
"Silicones and their Application to the Textile Industry"—F. L. Dennett, Dow-Corning Corp.

10:00 A. M. to 8:00 P. M. *Exhibits are open*—Florentine Room.

12 Noon to 12:15 P. M. *Annual Business Meeting*—Gold Room.

12:30 P.M. to 2:00 P.M. *Luncheon, National and Sectional Officers*—English Walnut Room.

2:00 P.M. to 5:00 P.M. *Cellulosic Fibers Group Meeting*—Pine Room.



ARTHUR H. BRAINERD
Dining

Chairman, George E. Osha, Munsingwear, Inc.
"Pigmented Resin Emulsions for Printing and Pad Dyeing"—Max Silverman, Sherwin-Williams Co.
"Practical Experience in Vat Acid Dyeing"—J. H. Hennessey, General Dyestuff Corp.
"Unwoven Fabrics: Their Future in the Textile Industry"—O. G. Edwards, Industrial Research Institute, University of Chattanooga.
"Textile Finishing Machinery"—Edw. S. Pierce, H. W. Butterworth and Sons Co.

2:00 P. M. to 5:00 P. M. *Non-Cellulosic Fibers Group Meeting*—Parliament Room.
Chairman, Robert C. Anderson, Cleveland Worsted Mills.
"The Manufacture and Processing of Quality Blended Fabrics"—Emory A. Richards,Lippitt Worsted Mills, Inc.
"Some Aspects of the Chlorination of Wool to Produce Shrink Resistance"—Milton Harris, Harris Research Laboratories.
"Chemical and Physiological Aspects of Moth Protection"—H. Luttringhaus, General Dyestuff Corp.

SAMUEL KLEIN
Exhibits

2:00 P.M. to 5:00 P.M. *Finishing and Auxiliaries Group Meeting*—Parlors A-B-C.
Chairman, Clarence W. Wille, Burson Knitting Co.
"Trends in the Evolution of Fire-Resistant Textiles"—Robert W. Little, Ellicott Laboratories, Inc.
"Synthetic Detergents in Textile Processing"—H. C. Borghetty, General Dyestuff Corp.
"Permanent Finishes on Rayon"—Leonard Shapiro, Alrose Chemical Company.

2:00 P.M. to 5:00 P.M. *Fundamental Research Group Meeting*—Parlor D.
Chairman, Leonard Armstrong, Armour & Co.
"Studies on Nylon Dyeing; Effect of Dyeing Procedures"—Louis I. Fidell, G. L. Royer and H. E. Millson, Calco Chemical Division, American Cyanamid Co. (To be presented by Mr. Fidell).
"The Effect of Fiber Physical Differences upon the Dyeing of Nylon Staple"—R. J. Thomas and B. F. Faris, E. I. duPont de Nemours & Co., Inc. (To be presented by Mr. Thomas).
"Some Aspects of the Aging of Coated Fabrics"—E. V. Painter, Fabric Research Laboratories, Inc.

ERIC W. CAMP
Hotel and Transportation

2:00 P.M. to 5:00 P.M.—*Hosiery Group Meeting*—Parlor K.
Chairman, Edward J. Siegrist, Holeproof Hosiery Co.
"Current Developments in Hosiery Dyeing and Finishing"—Edward J. Siegrist.
"Spun Nylon in Hosiery"—W. V. Vincent, E. I. duPont de Nemours & Co., Inc.
"A Simple Tester for Evaluating the Snag Resistance of Nylon Hosiery"—J. E. Smith and T. D. Johnson, Jr., E. I. duPont de Nemours & Co., Inc. (To be presented by Mr. Smith).

NORMAN G. KOEHLER
Entertainment

2:00 P.M. to 5:00 P.M.—*Testing Group Meeting*—Parlor M.
Chairman, Miss Laura E. Pratt, Sears, Roebuck & Co.
"Measurement of Stiffness and Resiliency as Related to Textile Finishing"—Lyman Fourt, Harris Research Laboratories.
"Problems Encountered in a Department Store Laboratory"—Arthur S. Eichlin, Marshall Field & Co.
"Determination of the Solubility of Dyes"—C. L. Zimmerman and H. R. McCleary, Calco Chemical Division, American Cyanamid Co.
"The Estimation of Vat Printing Pastes on Cloth and an Electrometric Analysis of the Critical Chemical"——Henry E. M. Specht, Cranston Print Works Company.

8:00 P.M. to 9:15 P.M.—*General Research Meeting*—Gold Room.
J. Robert Bonnar, Chairman of Executive Committee on Research, Presiding.
Open to all.

JOSEPH H. JONES
Finance

FRANK F. MEYERS
Ladies

JAMES S. MORRISON
Registration and Reception

GEORGE B. CHABOT, JR.
Printing

SATURDAY, OCTOBER 25, 1947:

9:00 A.M. to 12 Noon. *Personnel Service*—French Room.

9:00 A.M. to 7:30 P.M. *Registration*—Francis I. Room.

9:30 A. M. to 12:30 P.M. *Intersectional Contest*—Gold Room.
Patrick J. Kennedy, National Chairman, Presiding.

10:00 A.M. to 2:00 P.M. *Exhibits are open*—Florentine Room.

12:30 P.M. *Alumni Luncheon*—English Walnut Room.

7:30 P.M. *Banquet*—Gold Room.
Olney Medal Award.
Result of Intersectional Contest.
President's Address.
Address—Roger Adams, Head, Chemistry Dept., University of Illinois.

Committees

The following are the committees and their members:

Kenneth H. Barnard, *National Chairman.*

Elmer F. Smith, *General Chairman.*

Dining
Arthur T. Brainerd, *Chairman.*
Harold R. Calvert.
Louis Hoehn, Jr.
H. Thompson Latham.

Entertainment
Norman G. Koehler, *Chairman.*
Kenneth A. Coate.
Al. P. Roy.

Exhibits
Samuel Klein, *Chairman.*
Joseph R. Bentert.
Arthur J. Hultberg.
Paul F. Willgeroth.

Finance
Joseph H. Jones, *Chairman.*
Frank J. Acker.
Alfred J. Olson.
J. Gordon Stott.

Hotel and Transportation
Eric W. Camp, *Chairman.*
Robert O. Brenner.
Erwin J. Sindt.
Herbert W. Tetzlaff.

Ladies
Frank F. Meyers, *Chairman.*
Mrs. Victor C. Braun.
Miss Helen Braun.
Mrs. Louis Hoehn, Jr.
Mrs. Gerry R. Kremers.
Mrs. Frank F. Meyers.
Mrs. Herbert W. Tetzlaff.

Printing
George B. Chabot, Jr., *Chairman.*
Walter H. Jaeger.
Albert P. Wandtke.

Publicity
Winn W. Chase, *National Chairman.*
Elliott Morrill, *Local Chairman.*
Arthur A. Barker.
Edward C. Eaton.
Clarence W. Jameson.

Registration and Reception
James S. Morrison, *Chairman.*
Archie G. Alexander.
Frank F. Beverly.
Andrew F. Blackburn.
Louis W. Blank.
Victor C. Braun.
R. P. Cole.
Raymond M. Haas.
Gerhard R. Kremers.
Gilbert T. Latham.
Leslie B. MacFarland.
Charles E. Maher.
James G. Morgan.
Merrill G. Morris.
Elmer Scharf.
Patrick J. Kennedy, New York Section.
Arthur R. Thompson, Jr., Piedmont Section.

WINN W. CHASE
National Chairman, Publicity

HERMAN BOXSER
Local Chairman, Technical Program

ELLIOTT MORRILL
Local Chairman, Publicity

Harold L. DeTurck, Philadelphia Section.

Edward S. Chapin, Northern New England Section.

Howard M. Waddle, Southeastern Section.

Emory A. Richards, Rhode Island Section.

R. Wilburn Freeze, South Central Section.

Technical Program

Miles A. Dahlen, *National Chairman.*
Herman Boxser, *Local Chairman.*
Leonard Armstrong.
Jerome Kritchevsky.
Leslie O. Meyer.
Paul Soderdahl.

—♦ ♦—

December Meeting, Southeastern Section

THE Southeastern Section will have a meeting on December 6 in Atlanta, Georgia.

The speaker of the evening will be Thomas R. Smith, Manager, Yarn Dyeing Department, Wicasset Mills Company, Albemarle, N. C., and also a past president of the A.A.T.C.C. His subject will be "A Review of the Textile Reports of German Technical Developments." Mr. Smith was a member of the Textile Finishing Team which went to Germany in 1945 for the Quartermaster General.

—♦ ♦—

Fall Meeting, Piedmont Section

T Section will be held in Charlotte, Section will be held in Charlotte, North Carolina, at the Hotel Charlotte, Saturday, October 4th. Luncheon at 1:00 P.M. Saturday afternoon will replace the banquet usually held in the evening. The annual business session will follow the noon luncheon, at which time reports from the officers of the Piedmont Section will be made, and election of officers for the ensuing year will be held. The following have been nominated for next year's officers: *Chairman*—John B. Neely, Burlington Mills Corporation, Burlington, N. C.; *Vice Chairman*—P. E. Smith, Riegel Textile Corpotion, Ware Shoals, S. C.; *Secretary*—Robert H. Smith, Melrose Hosiery Mills, High Point, N. C.; *Treasurer*—Edwin A. Briggs, Southern Franklin Process Company, Greenville, S. C.; *Councilor* — Wyss L. Barker, National Aniline Division, Allied Chemical and Dye, Charlotte, N. C. Ballots with the above names have been sent to the membership and should be returned by mail at once. A technical session will be held at 3:00 P.M. Dr. Harold W. Stiegler, Director of Research for the National Association, will review the research work we are doing and reveal plans for the future. He will discuss methods by which the Piedmont Section might better conduct its individual research program.

Many of the members are planning to attend the annual North Carolina State-Davidson football game to be held in Memorial Stadium Saturday night. Reservations for the noon luncheon should be made through Robert H. Smith, Secretary. Football tickets are obtainable at Davidson College, Davidson, North Carolina.

Personnel Service

For the purpose of introducing members to prospective employers the Personnel Service will again operate, without charge, from Thursday afternoon through Saturday morning at the Chicago convention. Those seeking employment should if possible register before the meeting, but employers at the meeting as indicated below. Facilities will be offered employers for arranging interviews with representatives of educational institutions who register at the meeting.

Every candidate for employment should register in advance on two sets of blanks obtainable from the Secretary, P. O. Box 28, Lowell, Mass. Two photographs, approximately 2 x 2½ inches, will be necessary for attachment to the blanks. Late registrations, at the convention, will be accepted so far as facilities permit.

Employers, registering with the service at the beginning of the convention, may consult these qualification records and arrange appointments. Interviews will be arranged between 2 P.M. and 5 P.M. on Thursday, October 23rd; between 9 A.M. and noon, and 2 P.M. and 5 P.M. on Friday; and between 9 A.M. and noon on Saturday.

Further information can be obtained from the Secretary, or at the general registration desk in the Congress Hotel at the convention.

—♦ ♦—

Contest Chairman, Philadelphia Section

RICHARD B. STEHLE, Superintendent of Dyeing at the Allegheny Dye Works, Philadelphia, and Director of the Reading Dyeing Company, is the Chairman of the Intersectional Contest Committee of the Philadelphia Section of the American Association of Textile Chemists and Colorists. Mr. Stehle attended the Massachusetts Institute of Technology and received a B.S. in Ch. E. in 1920 from the University of Pennsylvania. He is a member of the American Chemical Society and the Franklin Institute.

Richard B. Stehle

—♦ ♦—

Contest Chairman, Southeastern Section

J. D. DEAN, Head of the Cotton Chemical Finishing Division of the Southern Regional Research Laboratory at New Orleans, is the chairman of the Intersectional Contest Committee of the Southeastern Section of the American Association of Textile Chemists and Colorists.

James D. Dean

Mr. Dean attended Keystone and Phillips Exeter Academies and Brown University. He has had considerable cotton and rayon piece goods finishing experience having been connected at various times with U. S. Finishing Co., Robertson Bleachery and Dye Works, Inc., and Pacific Mills. In 1941 he was with the Office of the Quartermaster General in Washington, transferring in 1942 to the Department of Agriculture.

REMEMBER!
OCTOBER 23, 24, 25

Old Dyers, Old Books and Old Methods

*Remarks on the History of Dyeing and Finishing**

SIDNEY M. EDELSTEIN
Dexter Chemical Corporation

JUST a few months ago, many of us assisted in the celebration of the 25th Anniversary of the founding of our Association. The jubilee edition of our journal published on that occasion contained over 300 pages devoted to the accomplishment of our industry and profession during the last 25 years. We well may wonder how many thousands of pages would have been required to tell the history of dyeing and finishing for the last 4,000 years. For the beginnings of our industry are one with the beginnings of civilization.

We may also ask of what use, other than the satisfaction of our natural curiosity would be this telling.

The best answer that we can give is the words of one who has long been a part of our country's past:

"History maketh a young man to be old, without either wrinkles or grey hairs; privileging him with the experience of age, without either the infirmities or inconveniences thereof. Yea, it not only maketh things present, but enableth one to make a rational conjecture of things to come. For this world affordeth no new accidents, but in the same sense wherein we call it a 'New Moon', which is the old one in another shape, and yet no other than what hath been formerly. Old actions return again, furbished over with some new and different circumstances."

Tonight, in our journey through the past, we shall be able to stop and sight the new moons only briefly and occasionally, for our trip must be a short one. Perhaps, some of you may find the sights along the way interesting enough to make the trip yourselves in a more leisurely fashion.

Dyeing and Alchemy

The belief in the reincarnation of the human soul is certainly a metaphysical question quite beyond the province of our discussion. The reincarnation of the art and science of dyeing is not. For it is a demonstrable fact. In the language of earlier days we may say: Dyeing begat alchemy, which begat chemistry, which begat modern dyeing: . . . .

**This paper was presented at the combined meeting of the Lowell Textile Institute Student Chapter and the Northern New England Section held on May 16th in Southwick Hall at the Institute in Lowell, Mass. Mr. Edelstein had on display a number of old books and manuscripts which he has accumulated over a period of years. Included in his collection are books on chemistry and alchemy and all of the books on dyeing and related subjects published in this country from 1798 to 1890. There are over 2000 items in his collection.*

The practice of alchemy, which sought to turn base metals into gold, "undoubtedly began in Egypt—in that country, where for forty centuries or more, a civilization had grown up on the banks of the Nile."

If Greece was the cradle of philosophy, and Palestine the cradle of religion, then Egypt was certainly the cradle of the arts. For the Egyptians were wonderful dyers, metal workers, and craftsmen, when the people of most countries were hardly more advanced than are the savages of certain Pacific islands now.

"The royal tombs filled with draperies dyed with 'royal purple' and intermeshed with gold and silver threads, the wonderful bronze and woodwork, the paintings, and a thousand other things, bear witness to the skill of the Egyptians in the manual arts."

"In a land of neutral hues, dyes, metals, and precious stones, satisfied the hunger of the people for color, and it was this hunger for color, which lead to the rise of alchemy."

For thousands of years, man classified materials, mainly by their physical attributes. The properties of matter were confused with matter itself. Thus, if a metal felt like gold, and particularly if it looked like gold, it was gold—as far as the ordinary man was concerned. Hence there arose an imitative art in Egypt, which provided the person of small means with fabrics dyed to look like the 'Royal Colors', metals colored to look like gold and silver, and artificial jewels, which looked like the real thing.

"The early artisans of Egypt joined two color industries in their workshops. They were first, dyers of fabrics, and second, bronzers or colorers of metals to which all the technical methods of alchemy may be referred. For it was only a natural step, for these dyers, to note, that on dipping hot metals into their various mordant baths, and then heating the metals, that these metals, acquired unusual colors or, became 'dyed'."

These early alchemists did not deceive themselves. They knew that they were not transmuting metals, but were simply coloring them.

But, as the art passed through the hands of the Arabians, and finally into medieval Europe, various false theories crept in. Since it was almost universally thought that metals grew in the earth just as did plants and vegetables, and that nature was constantly striving for perfection, and since gold was 'the perfect metal', then, within the bowels of the earth, the base metals were slowly being generated, and transmuted into gold. The theory of the alchemical art, finely, simply presumed to speed up nature's process, by chemical treatments of heating, distilling, subliming, amalgamating and fixing, and thus to convert the less perfect metals into real gold.

In spite of the false theories, and despite the many charlatans who adopted the art, a mass of data on chemical reactions and processes were accumulated through the years, and furnished the foundation on which modern chemistry arose. The development of the thousands of synthetic dyestuffs, and the modern techniques of dyeing and finishing through modern chemistry, is matter-of-fact to all of us today. But we should not forget the humble beginnings and the reincarnation of our industry, after many thousands of years.

Glauber and His Wonder Salt

"Remember the Glauber's salt", is as much a by-word to the dyers as is "Remember the Alamo" to Texans. While all of us have learned of the exploits of the defenders of the now famous Texas shrine, what do we know of Glauber and his wonder salt?

Johann Rudolph Glauber was not a dyer. He was an alchemist, a pharmacist, and a metallurgist. He was ignorant of many things and the most learned of all in some things. He was both a practical industrial chemist and a wide-dyed miracle believing visionary. In many ways he was a quack. Nevertheless, his contributions to chemistry and technology, and particularly, his discovery of crystallized sodium sulfate, merits as least briefly our attention.

Glauber, the son of a barber surgeon, was born in Germany at the beginning of the 17th centrury. Lacking formal education, he wandered from town to town while a young man, picking up bits of information, and working sparodically at odd jobs.

It was in Vienna, when Glauber was just 21, that the turning point in his career occurred. This event, which led to the discovery of Glauber's Salt, was Glauber's contraction of a 'burning fever', known by the name of the Hungarian Disease, which seldom any stranger escaped. Dragging himself from the city, he collapsed after traveling a few miles into the country. Friends advised him to drink of the water, 'near a certain vineyard'. Putting little stock in these words, he despairingly crawled to the well, dipped some bread into the water and ate a few crumbs. And as Glauber told the story of the miracle: "It relished me very pleasantly who before at home loathed the greatest dainties. Thereupon I made a cup of a hollow crust of bread, and drank the water, which so excited my appetite to eat, that at length I also ate my cup. I asked the inhabitants what manner of water that was? They answered, that it was water of Salt-Petre, which I believed being then unskilled in such things, but afterwards, I found the contrary."

Glauber spent the following years studying this wonderful spring, and the result was the discovery of crystallized sodium sulfate which he called his Sal Mirabile—The Wonder Salt. The claims made for this simple salt were fantastic, and in fact, Glauber believed that he had found the universal solvent, the universal medicine of the alchemists. More important, however, is the fact that Glauber's enthusiasm over the Sal Mirabile caused him to immediately begin the study of chemistry and alchemy to which the remainder of his life was devoted.

Johann Rudolph Glauber

—Courtesy of the Edgar F. Smith Memorial Collection, University of Pennsylvania.

Glauber lived a full and exciting life, dying in Amsterdam at the age of 61. To those who inquired, what legacy Glauber had left his wife and children, a friend replied: "Did Roger Bacon or Paracelsus leave vast riches? Glauber's wealth, like that of his learned predecessors, is to be found in his discoveries and writings." Surely, the cheap, common, but indispensable Glauber's salt, is a rich legacy, to all of us connected with the textile industry.

The Royal Society

His illustrious Majesty, Charles II, is entitled to more credit than that due, only, for his being one of the lovers in 'Forever Amber'. For it was this same Charles II, who by his interest and support, helped to place the struggling Royal Society on a solid foundation.

To those who have had the misfortune of having formed their impressions of 17th century England through modern novels, a picture is presented of a decadent country, interested only in brawling and pleasures, subject to plagues, and all the diseases of filth. There is another picture of these times, which while less interesting to many, is of much greater importance. This other picture is one of an awakened interest in learning, in science, and in technology. The Royal Society in the second half of the 17th Century, was as much a center of the social life of many of the well born, as

was the royal court for others.

The art and theory of dyeing, early aroused the interest of the Society. On April 30, 1662, Sir William Petty presented before a large group of members the first original account in English of the dyes, methods, and chemicals used in dyeing.

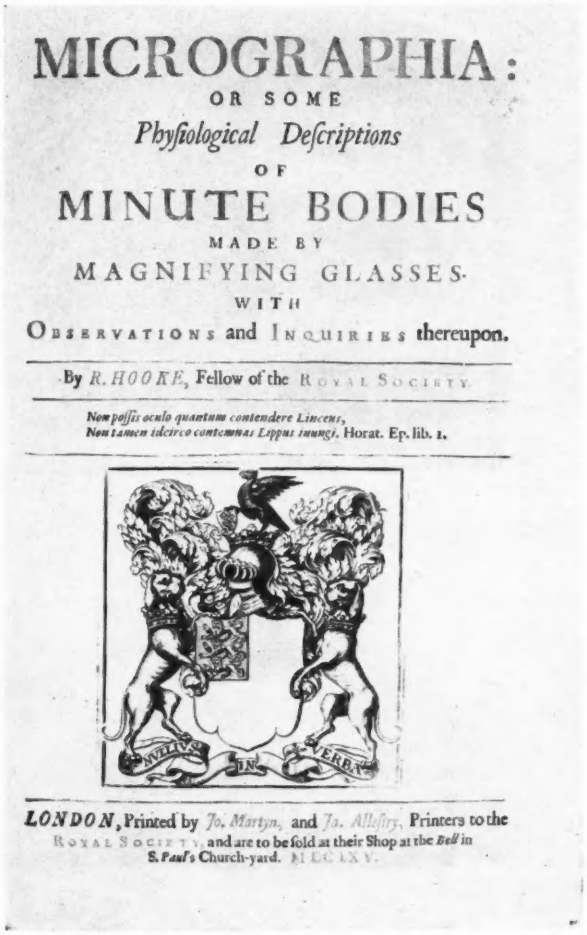
In this work, Sir William, while discussing learnedly the theory of colors and the action of dyestuffs, did not neglect to drop a few hints as to how the dyer might make a bit of extra profit. In speaking of the use of gums on silk, Petty says, "So gum may give the silk a glassiness, that is, may make it seem finer, as also stiffer; so as to make one believe, the said stiffness proceeded from the quantity of silk closewoven: and lastly to increase weight; for if an ounce of gum, worth a penny, can be incorporated into a pound of silk, the said penny in the gum produces three shillings, the price of an ounce of silk."

Among the illustrious group of men who were most active in the Royal Society, Robert Hooke is of particular interest to us, for Hooke was the first textile microscopist. He constructed one of the first compound microscopes, and through this microscope, he examined lawns, silk fabrics, hairs, and fibers of all sorts. His work culminated in the publication of "Micrographia", the first book devoted completely to microscopy.

Most of us are familiar with the oft quoted portion, from this book, which anticipated by some 200 years the manufacture of synthetic fibers, for every book on rayon mentions Hooke's prediction. The impression is general, however, that this publication lay unknown in dusty libraries, not to be noticed until modern times, and only because of the passage concerning artificial fibers. This is far from the truth, for the copies of the "Micrographia" were as eagerly bought upon publication, and as avidly read and discussed, as are today's best sellers. Even Pepys, the columnist of 17th century London wrote that, on the 20th of January, 1665, he went to his bookseller, "and there took home Hooke's book of microscopy, a most excellent piece, and of which I am very proud." Today, after two hundred and eighty-two years, I am also very proud to be able to exhibit a first edition of the "Micrographia." The book has stood the test of time.

Dr. Francis Home and the Bleaching Industry

In these days of high speed continuous bleaching, we tend to look with disdain on the bleaching practice of only a few years ago, when the process was a matter of hours, instead of minutes. The bleacher of 200 years ago, however, would have looked upon any bleaching process which could be carried out in a month as a miracle. For 200 years ago

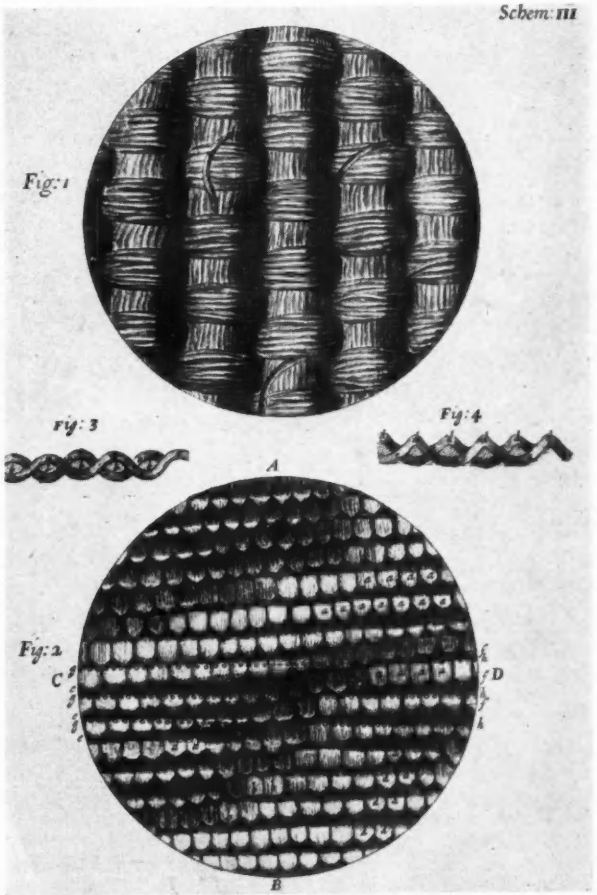

MICROGRAPHIA:
OR SOME
Physiological Descriptions
OF
MINUTE BODIES
MADE BY
MAGNIFYING GLASSES.
WITH
OBSERVATIONS and INQUIRIES thereupon.

By *R. HOOKE*, Fellow of the ROYAL SOCIETY.

Non possis oculo quantum contendere Lynceus,
Non tamen idcirco contemnas Lippus inungi. Horat. Ep. lib. 1.

LONDON, Printed by *Jo. Martyn*, and *Ja. Allestry*, Printers to the ROYAL SOCIETY, and are to be sold at their Shop at the *Bell* in S. *Paul's* Church-yard. MDCLXV.

Title Page of the First Edition of the Micrographia.
—Author's Collection



The First Textile Micrographs; Lawn and Watered Silk; Robert Hooke, 1665.
—Author's Collection

the bleaching industry was just on the threshold of leaving the technical stagnation in which it had existed for more than two thousand years. It was not as most people think, the introduction of chlorine which marked the end of this stagnation, but rather, the introduction of the scientific method in examining the problems of bleaching.

In tracing back the history of bleaching to the earliest times, it is difficult to distinguish between bleaching proper, laundering, and preparation of the goods for dyeing. Nevertheless, at some distant period, there arose a distinct art in the production of white fabrics. This art was probably practiced by the same artisans who prepared dyed fabrics.

It was not until comparatively recent times that bleaching, as a distinct industry separate from dyeing, came into existance. In any case the process was essentially the same through the centuries—boiling the goods in alkaline solutions, exposing to the sun and then repeating the process for many months, until the goods were clean and white. We think of fabrics dyed with Tyrian Purple as being the acme of luxury in ancient times. Actually, a pure white, well bleached garment, was even more sought after. This is understandable when we realize that a beautiful purple dyed fabric could be obtained in a matter of a few weeks, whereas, a simple white fabric took many months to prepare.

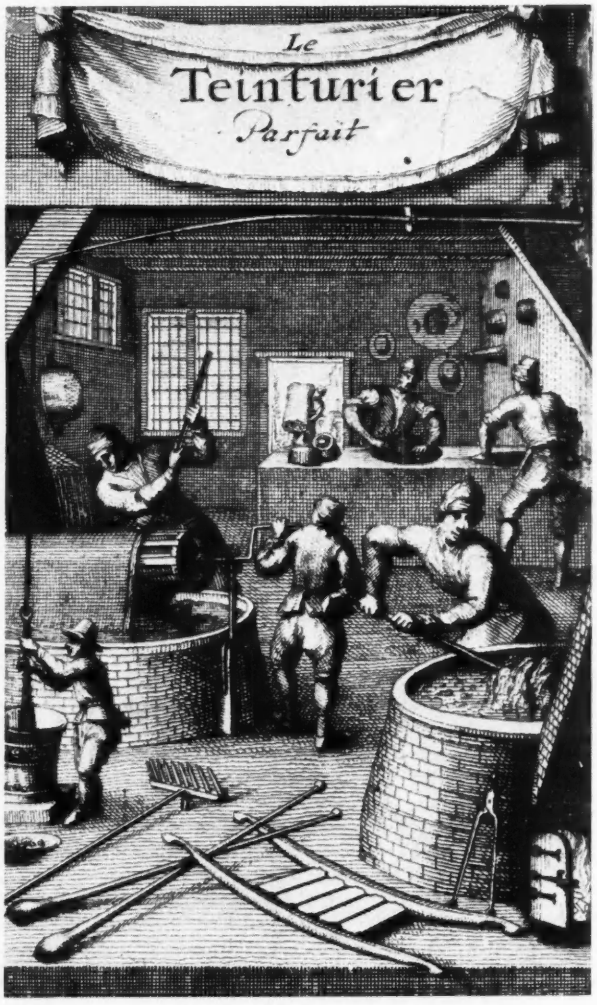
The system of bleaching, used by the ancients, was little changed during 2,000 years. Different alkalies were introduced from time to time, and every bleacher had his own special variation, but the process still consisted of alternate boiling and exposure of the goods to the sun.

In 1756, Dr. Francis Home of Edinburgh published what is probably the first book on bleaching. This book paved the way for the great chemical advances in the art which took place at the end of the 18th century. This book accomplished this by getting the bleachers interested in the chemistry of their processes for the first time.

In the preface to this work, Home summed up his main thesis in these words: "I find the most skillful bleachers understand the general theory of their art tolerably well, but being ignorant of the principles of chymistry, cannot make proper use of this theory, or apply their knowledge to the advancement of their art."

Home, by way of example, studied the bleaching industry in detail. He investigated the alkalies used, showed their method of action, and developed methods for their analysis. He showed that sulfuric acid could be used as the sour in place of stale milk, with better control of the process, and a saving in time and money. Finally, he was the first to study in detail the types of water hardness and the causes, the effects of hard water on the bleaching process, and chemical methods for the control of this hardness.

The introduction by Berthollet of the chemical method of bleaching, some years later, was the final link in the chemical chain forged by the Scottish physician, Home.



An Eighteenth Century Dyehouse.
—Author's Collection

An Eighteenth Century Dyehouse

It is often said, that an afternoon's visit to a dyehouse, is more informative than reading a dozen books on the subject.

Suppose we go together on an imaginary visit to a dyehouse of 200 years ago. This one visit will show us how dyeing was done and with what dyestuffs and chemicals the work was carried on in most countries, and in practically any period before the 19th century.

This dyeing establishment is located a mile or so from the town and is situated beside a fast running, clear stream of water. As we approach the small, one story stone building, we are beset with both pleasant and foul odors. As we learn later, the pleasant odors come from the casks of roots, barks and dried flowers, from which the colors are obtained, whereas the other smells are due to the fermenting indigo vat.

The dyer, dressed in black homespun, and wearing a heavy leather apron,

ushers us into the main dye house room and proceeds to point out the apparatus. In the center of the dirt floor are two caldrons, set into a brick furnace. Both are about 70 gallons capacity, and one is of copper, and the other of iron. We see a charcoal fire glowing brightly when the dyer opens the door to the furnace.

Beside the iron kettle a boy is stirring a dark bubbling liquor. Our friend tells us that logwood is being boiled, in preparation for dyeing some blacks on the following day. At another kettle we see an older man busily winding some woolen cloth over a winch and through a red liquor. The cloth appears to be a beautiful scarlet and we are told that this is being dyed for the rich merchant of the town.

Being interested in the dyes which are used to make this scarlet, we ask the dyer for information and he withdraws a little leather bound note book from his pocket and reads to us his precious formula.

"For seven pounds of cloth, take one pound of aquafortis duplex and one pound of water; put them in a glass vessel; add one ounce of salamoniac, gradually, having it pounded fine, add half an ounce of salnitre, shake them together; then add three ounces of granulated tin, allow to stand until the next day.

"Fill the copper with pure water; put in three pounds of wheat bran, enclosed in a bag. Let the water boil; then take out the bag of bran. Add 1½ ounces of creamtarter, let boil a few minutes, then add two ounces of cochineal. Boil fifteen minutes; then introduce one-third of the composition already prepared, and then dip the cloth for one hour. Repeat this process four times and on the fifth add two tablespoons of tumeric. Dip the cloth for a half hour, then take up and rinse it well for drying and pressing."

The dyer then asks us to come with him to the drug room, where we can see the different dyes and chemicals he uses.

In this small room the dyer then points out to us the more important drugs he uses. "That is cochineal, a little insect found in South America. It is shipped to Spain; from Spain to England; whence we obtain it at a high price. It is used in scarlets, pinks and crimsons.

"This keg contains Spanish indigo—the best of all. See how fine and soft it is. We use this in Saxon Greens. For most of our greens and blues, however, we use indigo from Carolina. It is excellent, and quite a bit cheaper than the other. This kind comes in bricks." Breaking a piece, he says, "See how easily it breaks ,and the bright shining purple. This is the test for the best Carolina."

Pointing to several boxes containing what appears to be kindling wood, our dyer says, "That is camwood, and this is logwood. This reddish brown wood, is barwood and that over there, is Brazil wood. We use logwood for blacks, and in many blues. Our dark browns are made with barwood, and many of our pinks and clarets with Brazil."

As it is growing late, our guide hastens through the little room, pointing from side to side, and showing us fustick for greens and drabs, madder for reds, woad for fast blues, saffron for brilliant yellows, and then the mordants and chemicals, coperas, oil of vitrol, alum, pot ashes, nutgalls and many other materials, the names of which we could not catch, as we trailed behind our host back into the dyehouse.

The dyer rushes over to a large wooden vat on one side of the room and, after lifting the cover, he turns to us and says that his fresh indigo vat, which he has been preparing for two weeks, seems almost ready and that he and the other men will have to spend the night getting the bath ready for the following day. We thank him for his kindness and leave, in all haste, to get back to the easier life of a dyer of the 20th century.

ASA Ellis and Cornelius Maloney

In a young country such as America where "expansion" is the catch word for business, industry, and the chambers of commerce, we tend to look upon the small villages and towns of our country as children who haven't as yet grown up. Actually many of our towns and villages are very old and it is often the large city which is the child—at least as far as age is concerned.

The early history of the dyeing industry in the United States is intimately connected with the small town. For the first three books on dyeing, published in this country, all bear the names of towns which today have less than 50,000 inhabitants.

As one might expect, New England has the distinction of claiming for its own the very first book on dyeing published in this country. The exact place of publcation however, was not Boston, nor Providence, nor any of the large cities, but tiny Brookfield, Massachusets—a town even too small to have its population given in the usual atlas.

In the records of the clerk, of the District of Massachusetts there is recorded the following historic document:

District of Massachusetts District, To Wit.

Be it remembered, That on the thirteenth day of November, in the twenty-third year of the Independence of the United States of America, ASA ELLIS, Jun. of the said district, hath deposited in this Office, the title of a Book, the

DISTRICT OF MASSACHUSETTS DISTRICT, TO WIT.

BE it remembered, That on the thirteenth day of November, in the twenty-third year of the Independence of the United States of America, ASA ELLIS, JUN. of the said district, hath depofited in this Office, the title of a Book, the right whereof he claims as Author, in the words following, to wit. "THE COUNTRY DYER's ASSISTANT, by ASA ELLIS, JUN."

In conformity to the Act of the Congrefs of the United States, entitled "An Act for the Encouragement of Learning, by fecuring the Copies of Maps, Charts, and Books, to the Authors and Proprietors of fuch Copies, during the time therein mentioned."

N. GOODALE, *Clerk of the Diftrict of Maffachufetts Diftrict.*

A true Copy of Record.
Atteft, N. GOODALE, *Clerk.*

Registration of the First Book on Dyeing Published in America, 1798.
—Author's Collection

right whereof he claims as Author, in the words following, to wit, "THE COUNTRY DYER'S ASSISTANT, by ASA ELLIS, Jun."

In conformity to the Act of the Congress of the United States, entitled "An Act for the Encouragement of Learning, by securing the Copies of Maps, Charts, and Books, to the Authors and Proprietors of such Copies, during the time therein mentioned."

N. GOODALE,
Clerk of the District of Mass. District.

Information on the author of this little book has been impossible to find, although a thorough search of local documents and papers might bring something to light. It is certain that Asa Ellis, Jr. was a good dyer and a clear thinker, for his little leather bound book of 140 pages bears testimony to this.

The city of Boston does have one special mark of distinction for us in this discussion, for it was the place of publication of an extremely interesting item in the history of dyeing—the first American book on dyeing, containing colored samples. It was most fitting that the author of this book was a son of Erin, with a true Celtic name—Cornelius Maloney.

Cornelius was certainly an enterprising man. He apparently left nothing unturned to see that his book, which was published in 1833 under the name of the "Practical Dyer", met with a ready sale. In fact, he made sure that his book would be a success, by taking orders before the book was even published. In the back of this book are listed 63 subscribers, each of whom agreed to take one copy at ten dollars per copy. Prices being what they were in 1833, Maloney's book was bound to have been a financial success.

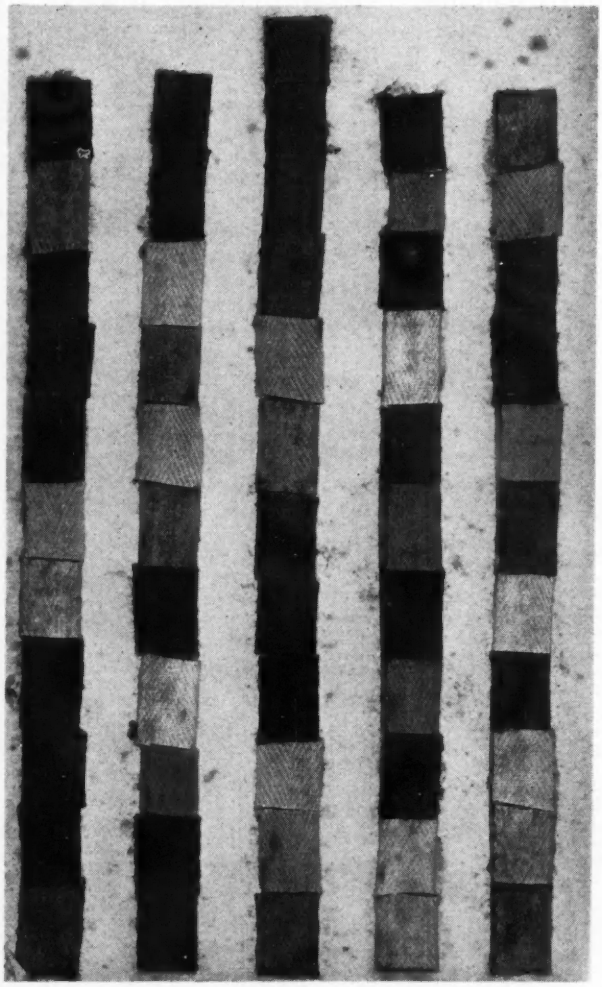
This long list of subscribers, of which almost half were from Lowell, also bear witness to Maloney's technical skill as well. For it is impossible to believe that 63 men would each agree to pay what was really a large sum for a book in those days unless the author had some important and worthwhile information to impart. The recommendation as to Maloney's skill in dyeing, which are printed in the front of the book, also indicate his good name. The last of these recommendations, is of particular interest to us tonight.

Lowell, March 23, 1832.

Cornelius Maloney has been in the employment of the Lowell Manufacturing Company as a dyer, and has given entire satisfaction. I think him a first-rate dyer.

I likewise, think him a first-rate woad dyer.

signed Alexander Wright,
Superintendent of Lowell Co.
Carpet Factory



Sample Dyed Cotton Swatches Prepared by Cornelius Maloney in 1833. Photographed after 113 Years.

—Author's Collection

Cornelius Maloney must have been a first-rate dyer, for the little swatches dyed by him over 114 years ago, are still brilliant and full of life. The colors have resisted the passage of time, for the most part, better than the fabrics themselves. We may wonder how our own handiwork will look in the year 2090. Only time can give the answer—after we have also, became a chapter, in the history of dyeing.

A Versatile Dyer

In this age of specialization, we look askance on the Jack-Of-All-Trades. In our own profession, many of us are a bit vocal on the current political situation, but did you ever hear of a dyer running for judge? Some of us are amateur cooks, and can probably do an excellent job with a sirloin steak, but what textile chemist would dare write a book on the elements of cookery and the methods of serving. The presence in most plants of the first aid kit in the laboratory, gives many of us chemists a slight feeling of closeness to the surgeon and physician, but can you envision any of us calling on patients after a long day in the dyehouse?

In the early days of our country, things were different. A man could be a dyer, a physician, a lawyer, and a politician without a single brow being raised. In fact, in the early days, a man often had to be a Jack-Of-All-Trades to even earn a living.

Thomas Cooper is a perfect example of such a versatile person. The textile industry can claim him, and so can medicine, law, and politics. His life, which was a long one, covered some of the most interesting and important moments in our country's history.

His name is eminently connected with that of John Adams, Thomas Jefferson, Benjamin Rush, Joseph Priestley and even with Robespierre. His publications discuss slavery, the freedom of the press, the law of libel, political economy, cooking, chemistry, geology, medicine, and of course, dyeing and calico printing.

He was both loved and hated but always respected. Scarcely any newspaper, published in the first quarter of the 19th century, failed to have some article praising, or attacking, this man. Yet today his name is unknown except to a few scholars.

Our interest as textile chemists in Cooper lies with his publication in Philadelphia, in 1815, of "A Practical Treatise on Dyeing and Calico Printing." In the preface to this book, after commenting on the two books on dyeing, printed earlier in this country, and on his own practical experience, Cooper says with his characteristic lack of modesty, "Still I send out this book, as upon the whole, the best book on the subject of dyeing and printing now extant, scanty, as the information may seem."

This book was an excellent one, and it wielded considerable influence on the infant dyeing industry of this country. A contemporary reviewer pronounced it; "One of the greatest benefits conferred upon the useful arts of this country, and an extensive prospect of improvement to every dyer." The plan of the book, and incidentally Cooper's views on the training of a dyer, are given by Cooper in the following words: "Suppose I were a dyer, and a young lad sent to me to be instructed in the arts; I should first expect of him a good knowledge of the elements of chemistry; for it is a farce to talk of a dyer who is ignorant of chemical science; every step he takes must be in the dark; he cannot move, but by rote.

"I should then instruct him in the materials used in the art of dyeing, and should then carry him, if I could, to the best dyehouses in the neighborhood, and show him the processes, that are used for each color, on the respective kinds of stuff.

"Then I would bring him home, and make him dye the same colors, in my own dye house, explaining the reasons of difference, wherever my practice differed from my neighbor's.

"I have done so in this book. I have placed the reader in the French, the German, the English dyehouses; I have given him the processes of each country, where, I could get at them.

Thomas Cooper in Old Age in South Carolina. Silhouette done from life by William H. Brown and first Published in his Portrait Gallery of Distinguished American Citizens, 1846.

—Author's Collection

"The art of dyeing, is yet in its infancy. No one but a good chemist, who is at the same time a good dyer, can form any judgment, of the very many unascertained points, that yet remain in this art. I have felt this, at almost every page of the work. It is in dyeing, as in all other branches of knowledge, a man must know much, before he is aware how ignorant he is. The only cure for the evil, is a general introduction of chemical knowledge, which bears upon the principles of almost every art and trade, that subserves the comfort or convenience of common life."

Thus ends Cooper's thoughts on the subject.

Thomas Cooper was born in London in 1759 and was educated in science, law, medicine and letters, at Oxford, and other universities.

While a young man in his thirties, he became politically what today we would call a leftist and hastened to France, which was then in the midst of the revolution. Cooper's stay in France was short, for he did not hesitate to challenge the terrible Robespierre to a duel, and just managed to escape the guillotine by the timely warning of a friend.

This country beckoned the young man and together with Joseph Priestley, the discoverer of oxygen, he settled in North Thumberland, Pennsylvania, became a naturalized citizen, and was admitted to the bar.

Cooper had a penchant for fights and it wasn't long before he was in jail serving a term for libeling President John Adams. Discussing this affair later he said: "It got me in jail, where I stayed six months. But there I had good company every day. At night I had the best company in Philadelphia. Everything that was good was sent to me—claret, madeira, port, cider—everything came. God knows how or from where, and cost me nothing. However, I had to pay a fine of $400.00."

Cooper then devoted his time to chem-

ical education. He became in succession professor of chemistry at Dickinson College, at the University of Pennsylvania, and finally, at the University of South Carolina. Each change of position came about because of Cooper's outspoken ways. There was someone always around of importance on whose feet he trod.

In the South, Cooper was warmly received and was even appointed president of the University of South Carolina. His bitter tongue and vehement pen could not be controlled, however, and finally, in his old age, he was again without a job. Cooper died in South Carolina at the age of 81. His life was a full one, and he left his imprint on many important phases of the industrial and political life of this country. He was certainly one of the most interesting dyers that ever lived.

Perkin and Synthetic Dyestuffs

The year 1856 marks the final milestone and the entrance to the "promised land" on our long historical journey. For in the spring of that year, Perkin discovered mauve—the first coal tar color.

The details of this great discovery are known to every young science student. The perserevance of the 18 year old Perkin in pushing through the commercial adoption of this color and its technical production within a year, in spite of the discouragement offered by his teacher, and the dyers and printers, has long been an inspiration to all young men with a new idea.

The introduction of mauve completely changed the art of dyeing. The processes were simplified and scientific recipes furnished by color manufacturers were substituted for the old-time rule of thumb formula. Where before the dyes were complex, unstandardized mixtures derived from natural products and subject to all the variations that climate, soil, and the human element could cause, they now became definite chemical substances which could be tested, analyzed and applied by standard methods.

After Perkin had removed the obstacles in the path of practical application, and had shown the way for the commercial production of aniline and benzol, it became comparatively easy to introduce other coal tar colors.

Color after color was rapidly discovered and introduced to an eager dyeing industry. Alizarine and finally indigo were synthesized and the synthetic products replaced madder and natural indigo. A new industry was born which completely changed within a short time the political and commercial pattern of the world. Even the health of man was affected by this discovery of the young English chemist, for the humble coal tar rapidly yielded medicines and drugs of powers and properties undreamed of before. New anesthetics, aspirin, and finally the sulfas, all stem from the hunt for better and more brilliant dyes for the textile industry. The ugly black tar, which before 1856 had simply been a troublesome mess which interfered with the chemist's crystalline compounds, is today one of the greatest sources of wealth and well being.

In 1906, on the fiftieth anniversary of Perkin's discovery of mauve, a great jubilee celebration was held in London and later in New York and Boston. This Section can claim a certain honor in this celebration, for your own Alan Claflin was instrumental in persuading Sir William to come to this country for the occasion, and both he and Dr. Olney served on the International Committee of the Jubilee.

At the celebration in New York, 41 years ago, Sir William Perkin had this to say:

"The wonderful growth of this industry has also, as a matter of course, created not only directly but indirectly, an immense amount of employment for men of all classes, especially for the working classes, and although America has not become a manufacturing center for the production of these dyes, no doubt many thousands of American workers are engaged in the application."

The latest chapter in the history of the synthetic chemical industry is still being written—but this time by America.

Thus our journey through the past comes to a stop—not because of a dead end street, but because ahead the road is under construction. All of us are builders of the pathway of textile and chemical history, however humble or great our part in this construction may be. Although the road has twisted and turned and often detoured, there is an inspiration for all of us in the fact that the building of this road has never stopped.

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Discussion

Question: Can you tell us some more about alchemy?

Answer: Alchemy is looked upon by many of us as a thing having to do with the Black Art. Actually, alchemy's name is considered to be derived from the Egyptian word 'chem', which meant black. Alchemy, however, did accomplish a great deal in developing many chemical reactions and processes which have even come down today to us and which are still of use. The alchemists may really be divided into three classes. There are first, the quacks. Alchemy was an interesting thing to most of the people and there was a certain amount of romance behind it. There were many fakers who felt that this was a good chance for them to make a little money. Many of these false alchemists used the ordinary tricks that any magician today might use to prove that they could turn base metals into gold. They used such things as coating a gold nail halfway with an alloy and then upon dipping the nail into a certain solution, the alloy would be removed and show real gold underneath. They also used such tricks as hiding a small amount of gold in the bottom of a crucible and similar things. They were responsible for giving the bad name to alchemy. There was also a large group of true alchemists who sincerely believed that base metals could be turned into gold and that all that was required was to find a catalyst or the philosopher's stone. They started with a false theory in those days but they carried on their studies in a sensible way. They never found the philosopher's stone but they did do a great deal of work in chemistry. Much of the apparatus that we find in our present day laboratory and even in many manufacturing plants, can be traced directly to the work of the alchemists. In the light of modern chemistry and physics, however, the alchemists' original premise was certainly right for one element can be transmuted into another today. The third class might be called the religious or philosophical alchemists. They started with the premise that since the basic theory of alchemy was to change the less pure metals into gold, then the same principle should hold true with the human soul. The human soul was normally an impure thing but by the proper catalyst, the human soul could be turned into the pure essence of life and man by following many of the alchemical principles in connection with his own religious thoughts could become pure. The philosophical alchemists used many of the symbols and words of practical alchemy and built up a great mystical theory. Actually, as time went on, all three of these groups became intermixed. Actually, some of the real alchemists used some of the methods of the quacks in order to get money to carry on their honest work and many of the working alchemists became imbued with the philosophical side. The literature of alchemy today is a very complex mixture of mystery, philosophy, religion and many other things, and in fact, its study requires the knowledge of almost a new language.

Question: How did you get your book collection together?

Answer: My collecting started some twenty years ago when I was at Tech. I happened to pass an old book store which had a number of 'Techniques', that is, a college year book for sale. Some of these books contained pictures and information about some of my professors when they were young men going to school. This interested me so, that I began to realize that the people in the past were just as human and just as interesting as the people who are living today. I continued to buy a few books and before long I found that I was bitten with the collecting bug and couldn't get away. As far as finding the more important books, you don't find them lying around. Occasionally, you find something unusual, but generally, the building up of a historical library in science means sending off some nice big checks to dealers in New York and in London. It is the only way that you can get it together.

Question: Was dyeing and textile chemistry taught in schools in this country 150 years ago?

Answer: The answer is no. There was no special course in dyeing or textile chemistry in this country 150 years ago, but surprisingly enough, many of the colleges and universities had chemical courses which might be called today industrial chemistry. These courses discussed the relationship of chemistry to dyeing, manufacture of iron, preparation of foods, etc. It is surprising to realize the great interest in chemistry in the early days of our country. In fact, chemistry was one of the most important subjects given in the colleges and universities and a young man and a young woman were not considered educated unless they had a certain amount of chemistry. Chemistry was apparently even taught in the home in the early days of this country for there was one book called, "Conversations on Chemistry" which went through at least thirteen editions and sold thousands of copies. This book was written for the young person and particularly for girls. It is in a conversational form and discusses a talk on chemistry and its relation to daily problems such as dyeing and cooking. The first professor of chemistry in this country was of course, Benjamin Rush, the signer of the Declaration of Independence. His course in chemistry began about 1769 or 1770 at the University of Pennsylvania. Among the early professors in chemistry were McLean at Princeton, Woodhouse at Pennsylvania and Benjamin Silliman at Yale. It is interesting to note that Silliman was made a professor of chemistry when he was a young man in his early twenties. Most of the teachers of chemistry in the early days of this country were young men and had the normal interest in things new which usually go along with younger men. They were at the front in pushing through the new doctrine of the 'Modern Chemistry' of Lavoisier and we may be proud that the younger chemists of this country helped materially in the overthrow of the phlogiston theory which had held back the advance of chemical thought for almost a hundred years.

Question: Can you tell us something of ancient dyeing in China and India in relation to dyeing in Egypt?

Answer: Do you mean whether the dyeing carried on in China and India was derived from Egypt or related to it? In that case we may say that the dyeing in China and India was very similar to that carried out in ancient Egypt. We do not believe that there was a direct connection between the three countries as to their technique, but we do know that many similar dyestuffs were used in all three

countries. For example, China, India and Egypt used the blues derived from shellfish and also many of the vegetable colors. The colors from insects such as kermes were also used in India and Egypt thousands of years ago. We do not know of any direct connection between the industries of these countries in the early days, but there may well have been.

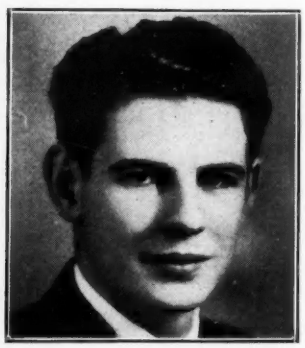
Question: What cotton dyes were there before the present coal-tar derivatives?

Answer: The cotton dyes were all of vegetable or animal origin and were prepared with mordants. The same basic type of dyes used on wool and silk were also used on cotton. Cotton suffered from this in the fact that most of the colors were not fast on the cotton towards light and washing as they were on wool and silk. On cotton, such things as logwood, woad, indigo, cochineal, madder and many of the other colors which we have already discussed were used together with mordants of alum, iron, tin and many others. Nutgalls were also widely used as mordants on cotton.

—♦ ♦—

Contest Chairman, South Central Section

DR. RAYMOND B. SEYMOUR, Director of the Industrial Research Institute at the University of Chattanooga, is Chairman of the International Contest Committee of the South Central Section of the American Association of Textile Chemists and Colorists. Dr. Seymour received his B.S. and M.S. from the University of New Hampshire and his Ph.D. from the University of Iowa. He is a Councilor of the American Chemical Society, Chairman of the Research Committee of the South Central Section of AATCC and a Member of the National Program Committee of AATCC, an active member of the American Institute of Chemical Engineers, a fellow of the American Institute of Chemists, Chairman of the Chemistry Section of the Tennessee Academy of Science, and a member of the American Oil Chemists Society, American Society for Testing Materials, American Society of Engineering Education, American Association for the Advancement of Science, Chattanooga Engineers' Club, Alpha Chi Sigma, Phi Lambda Upsilon, Sigma Xi, and Rotary Club. He was previously employed at the University of New Hampshire, the University of Iowa, Goodyear Tire and Rubber Company, Atlas Mineral Products Co., and Monsanto Chemical Co.



Dr. Raymond B. Seymour

—♦ ♦—

Contest Chairman, Piedmont Section

DR. R. E. RUPP, superintendent of Pacific Mills, Lyman, S. C. is chairman of the Intersectional Contest Committee for the Piedmont Section of the American Association of Textile Chemists and Colorists. Dr. Rupp received his A.B. from Dickinson College and his Ph.D. from Yale University. He is a member of the Council and Research Committee of AATCC and a member of the American Chemical Society.

Dr. R. E. Rupp

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Chicago Convention
Oct. 23, 24, 25
Congress Hotel
Auspices of
Mid West Section

EMPLOYMENT REGISTER

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47-34

Education: Columbia University, one year.
Experience: Laboratory asst., and operator of most machines in bleachery and dye house.
Age 35; married; references; prefers N. E. or N. Y.

CALENDAR

PHILADELPHIA SECTION
Meetings: September 26 (Kugler's, Philadelphia), November 8 (Silver Anniversary Meeting) (Bellevue-Stratford Hotel, Philadelphia), January 16, 1948, February 27, April 9, May 21 (Kugler's, Philadelphia).

NORTHERN NEW ENGLAND SECTION
Meetings: September 25, November 21.

SOUTH CENTRAL SECTION
Fall Outing, September 5 and 6 (Lookout Mountain Hotel).

PIEDMONT SECTION
Fall Meeting: October 4 (Hotel Charlotte, Charlotte, N. C.).

NEW YORK SECTION
Meetings: September 26, December 5 (Swiss Chalet, Rochelle Park, N. J.).

NATIONAL CONVENTION
October 23, 24, 25 (Congress Hotel, Chicago).

SOUTHEASTERN SECTION
Meeting: December 6 (Atlanta, Ga.).

Twenty-Fifth Anniversary Meeting, New York Section

THE New York Section will celebrate its twenty-first anniversary at a meeting to be held at Kohler's Swiss Chalet, Rochelle Park, N. J., on September 26th.

A brief review of the early history of the section will be presented by one of the first chairmen.

The speaker of the evening will be Lew Hahn, General Manager of the National Retail Dry Goods Association, whose subject will be "Past and Future in Textiles from the Consumers' Point of View." He will review developments in the past twenty-five years and indicate what may be expected in the next twenty-five years.

Most of the living past chairmen have signified their intention of being present at this meeting.

Properties of Water Repellent Fabrics*

J. W. ROWEN and D. GAGLIARDI

Abstract

A review and analysis of the theory of water repellency of textile fabrics has been made. The physicochemical basis underlying the wettability of water repellency of treated fabrics is discussed. A survey of the laboratory test methods for evaluating water repellency of textile fabrics is presented. A study was made on the water repellent properties of eleven commercial raincoats and four military fabrics. For this study two of the more recent test methods were examined, the Drop Penetration and the Contact Angle tests. Two other and older test methods were also studied, the Spray Rating and the Hydrostatic Pressure tests. Several exploratory observations were made in an attempt to understand the mechanism by which water repellent fabrics lose their repellency when exposed to rain.

I. Introduction

The National Bureau of Standards has been called upon from time to time to supply information dealing with "water repellent" fabrics. These requests have usually come from Government Agencies and the public at large. In recent months there has been an intensified interest in this subject, and the N.B.S. decided to review the field of "water repellency" and to carry out a laboratory study in order to answer present and future questions regarding this subject.

An examination of the literature [1]† revealed the existence of a large number of chemical compounds and commercial treatments about which extraordinary claims were made. Further investigation showed that a large number of laboratory test methods had been devised for evaluating "water repellency." Moreover, considerable confusion was encountered concerning the interpretation of the test results and the meaning of such terms as "waterproof" and "water repellent," "showerproof" and "water resistant" fabrics. It appeared desirable, therefore, to make a survey of the field of "water repellency" and to carry out some laboratory studies on currently available materials. This report, therefore, will deal mainly with the fundamental nature of "repellency," the laboratory methods used to evaluate it in fabrics, and some laboratory observations by the authors on a variety of raincoat fabrics.

II. The Theory of "Water Repellency"

We must at the very beginning distinguish between "waterproof" and "water repellent" textile surfaces. There is still a great tendency to mention both terms simultaneously and interchangeably, in spite of the numerous papers [2,3,4] which have been written to call attention to the great difference between them. A waterproof fabric is one in which the pores, the open spaces between the warp and filling yarns and between the fibers, are filled with appropriate substances resulting in a fabric having a continuous surface and a very small air permeability. A water repellent fabric is one whose fibers are usually coated with a "hydrophobic" type compound and whose pores are not filled in the course of the treatment. The latter types of fabrics are quite permeable to air and water vapor. The characteristics of the two types of fabric surfaces are summarized below:

	Waterproof	Water Repellent
Pores	filled	unfilled
Water vapor Permeability	very small	small or large
Air Permeability	small	usually large
Chief characteristic	extremely resistant to passage of water even under a hydrostatic head	resistant to wetting by rain drops and to the spreading of water over the textile surface but permits the passage of water under a hydrostatic head

From the foregoing it is seen that a "water repellent" textile surface may never be truly waterproof and that a "waterproof" textile surface does not necessarily have to be water repellent. Unless the pores of a raincoat or shower resistant jacket are large enough to permit transpiration the wearer will be extremely uncomfortable due to excessive perspiration. The water repellent fabrics are, therefore, more suited in this respect for making raincoats or shower resistant jackets. The subject of waterproofing of textiles is very extensive and beyond the scope of this paper, so that we shall restrict our discussion to the subject of water repellent textile surfaces.

As the term implies, a water repellent textile surface is one which appears to "repel" water. In such cases, the water does not wet or penetrate the surface of the textile fabric. The tendency of a solid to resist wetting is a function of:

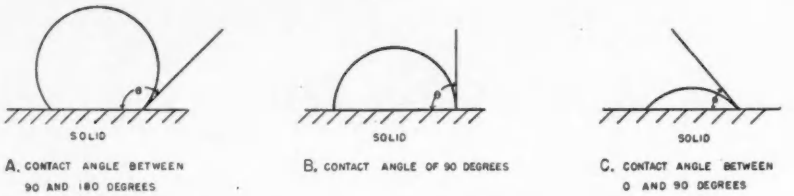
(a) the chemical nature of the solid surface
(b) the roughness of the surface
(c) the porosity of the surface
(d) the presence of other molecules on the surface

When a drop of water comes to rest on a solid, it may assume one of the forms shown in Figure 1, or any intermediate form from complete wetting to complete non wetting. Which form the drop will take is determined by the above mentioned variables.

Examination (fig. 1) of the angle of contact—the angle formed by the tangent to the drop at the point of contact with the surface (angle measured through the liquid)—reveals that the size of the angle is related to the repellency of the surface. When the angle of contact is small (less than 90°) the surface is said to be wettable [5, 6] and when the angle is large (larger than 90°) the surface is said to be nonwettable or repellent. Further consideration of the energy relationship of the drop-surface system as depicted in Figure 2 reveals that the equilibrium condition is due to the following surface energies:

γ_{sa}
γ_{la}
γ_{sl}

* Reprinted from Journal of Research of the National Bureau of Standards, January, 1947.
† Figures in brackets indicate the literature references at the end of this paper.



A. CONTACT ANGLE BETWEEN 90 AND 180 DEGREES

B. CONTACT ANGLE OF 90 DEGREES

C. CONTACT ANGLE BETWEEN 0 AND 90 DEGREES

Figure 1. Shapes of Drops on Solid Surfaces

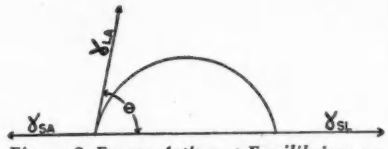


Figure 2. Forces Acting at Equilibrium on Drop-Solid System

where γ_{sa} is the free surface energy per square centimeter (numerically and dimensionally equivalent to the surface tension) of the solid in contact with air, γ_{la} is the free surface energy per cm² of the liquid when in contact with air, and γ_{sl} is the free surface energy per cm² of the solid when in contact with the liquid. At equilibrium, the following relationship holds:

$$\gamma_{sa} = \gamma_{la} \cos \Theta + \gamma_{sl} \quad (1)$$

Dupre [7] first derived the equation relating the free surface energies with the work of adhesion:

$$W = \gamma_{sa} + \gamma_{la} - \gamma_{sl} \quad (2)$$

From (1) and (2) it follows that:

$$W = \gamma_{la} (1 + \cos \Theta) * \quad (3)$$

Therefore, by measuring Θ and the surface tension of the liquid, one may calculate the work of adhesion between the liquid and the surface of the solid. It is clear that the smaller the work of adhesion, the smaller will be the wettability and the greater will be the repellency. For poorly repellent, easily wettable surfaces, the drop of liquid will assume a shape similar to C in figure 1; and for highly repellent, nonwettable surfaces, the drop will assume shape A.

Since textile fabric surfaces are not smooth, continuous surfaces, but rather porous, screen-like surfaces, one must examine the above considerations and see how they apply to textiles. Figure 3 shows the cross section of an idealized fabric. In this figure the parallel yarns are shown as circles. If the angle of contact between water and the surface of the fabric is larger than 90°, the equilibrium position of the water level of a drop of water will be, as indicated by the line AA, well outside the fabric. If, however, the angle of contact is much smaller than 90°, the water will penetrate the pores and the level will fall to some position such as BB. Cassie and Baxter [9] have shown that in the case of porous surfaces the apparent angle of contact is related to the continuous surface-water angle of contact in the following way:

$$\cos \Theta_a = f_1 \cos \Theta - f_2 \quad (4)$$

where Θ_a = the apparent angle of contact
Θ = the angle of contact
f_1 = the fraction of the plane geometrical area of unity parallel to the rough surface occupied by the solid-liquid interface
f_2 = the fraction of the plane geometrical area of unity parallel to the rough surface occupied by the liquid-air interface.

They also derived the relationships between the "f"* variables, the distance between the fibers in the yarns, the radius of the fibers, and the angle of contact:

$$f_1 = \frac{r}{r+d}\left(1 - \frac{\Theta}{180}\right) \quad (5)$$

$$f_2 = \frac{r}{r+d} \sin \Theta \quad (6)$$

where r = the radius of the fibers
d = ½ the distance between the fibers
Θ = the contact angle between the water and the fiber.

From the above, it appears as though the most water repellent fabric will be the one on which the drop assumes a form as shown in 3A. This condition may be obtained by adjusting the variables previously mentioned as being responsible for the form of the drop. It is advisable to consider each of the variables separately:

(a) *The chemical nature of the solid surface.* When purified, the natural fibers, cotton, wool, silk, etc. are hydrophilic in character and hence the drops assume shapes similar to B (fig. 3). It is common practice, therefore, to treat fabrics intended to be water repellent, with various hydrophobic compounds—compositions of waxes, petroleum-like molecules, and soaps of polyvalent metals which deposit a long chain hydrocarbon molecules on the surface of the fabric. When properly treated with a water repellent agent, the surface of the fabric will cause a water drop to assume a form very similar to A in figure 3.

(b) *Roughness of the surface.* Wenzel [10] pointed out that roughness has a peculiar effect on the angle of contact. He employed Freundlich's [11] concept of "adhesion tension" which is defined as follows:

$$A.T. = \gamma_{la} \cos \Theta \quad (7)$$

It is noted that the adhesion tension is the difference between the work of adhesion per sq cm (eq 3) and the surface tension. Wenzel recognized that equation (7) was true only in the case where the surface was a mathematical plane. Since most surfaces are not of this type, there is associated with each surface a roughness factor "R" which is the ratio of the actual surface to the geometric surface. Wenzel

Figure 3. Drops on Surface of Idealized Yarn

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* The work of adhesion (W) defined above is the amount of energy necessary to destroy one cm² of liquid-solid interface and to form one cm² of liquid and a one cm² of solid surface in contact with air. Now the energy of a unit area of solid surface in air may be somewhat different from the energy of a unit area of solid surface in vacuum. The difference between these two energies will depend upon the relative humidity, the hydrophobicity of the surface, the presence of transient gaseous or solids in the air, etc. It is physically impossible to separate a solid and a liquid without leaving the solid covered with at least a monolayer of liquid [8]; however, it is desirable to define a work for such a process, which is shown to be given by

$$W' = \gamma_{so} + \gamma_{lv} - \gamma_{sl}, \quad (1')$$

where
γ_{so} = free surface energy per sq. cm. of solid in vacuo,
γ_{lv} = free surface energy per sq. cm. of liquid in equilibrium with its vapor,
and γ_{sl} has the same meaning as before.

Now, for the clean solid in vacuo, the following relationship, analogous to (1) may be postulated

$$\gamma_{sv} = \gamma_{lv} \cos \Theta + \gamma_{sl} \quad (2')$$

where γ_{sv} is the free surface energy per sq. cm. of the solid in equilibrium with saturating vapor of the liquid. It follows from 1' and 2' above that

$$W' = \gamma_{so} - \gamma_{sv} + \gamma_{lv} (1 \cos \Theta). \quad (3')$$

If we assume $\gamma_{lv} = \gamma_{la}$ (which it will be within very small experimental error), we have

$$W' = \gamma_{so} - \gamma_{sv} + W. \quad (4')$$

The quantity $\gamma_{so} - \gamma_{sv}$ may be looked upon as the free energy of immersion, at constant temperature, of a unit surface of clean solid immersed in a saturated vapor and is given by [8].

$$\gamma_{so} - \gamma_{sv} = RT \int_0^P \Gamma_2 \, d \ln P, \quad (5')$$

where Γ_2 is Gibbs' "surface density" of the vapor on the solid surface and equal to $q/M\Sigma - T/V_2$,

where q = the quantity of water vapor adsorbed per gram of absorbent,
M = molecular weight of the vapor.
Σ = area in sq. cm. per gm. of solid
T = thickness of the surface region.
V_2 = molal volume of the vapor.

The right-hand member of 5' can be integrated if an equation for the adsorption isotherm is known or, if not, a graphical integration of the area under the isothermal curve can be carried out.

showed the validity of the following equation:

$$A.T. = \gamma_{la} \frac{\cos \Theta}{R}. \quad (8)$$

(c) *Porosity of the surface.* Cassie and Baxter [9, 12] pursued the idea of the roughness factor and showed that the apparent adhesion tension of a porous surface was given by:

$$A.T._a = \cos \Theta_a \cdot \gamma_{la} = \gamma_{la} (f_1 \cos \Theta - f_2) \quad (9)$$

where the symbols have the same meaning as in equation (4). Using a hexagonal idealized yarn pattern as a model, the above workers showed that σ, the bulk density of the yarn, was related to the radius of the fibers in the following way:

$$\sigma = \left(\frac{\pi}{2\sqrt{3}}\right) \frac{\varrho r^2}{(r+d)^2} \quad (10)$$

where ϱ is the density of the fiber. With the aid of equations (4), (5), (6), and (10), they were able to obtain plots of contact angle versus σ. These plots showed that the angle of contact approaches 180° as σ approaches small values (about 0.1 gram/cc). Their theory led them to the position that fabric structure was extremely important in the production of water repellent fabrics.

(d) *The presence of other molecules on the surface.* It is a well known fact that the surface properties of solids may be greatly altered by covering the surface with impurities, greasy films, dust particles, water and gas vapors, etc. The presence of surface impurities may or may not be related to the fact that numerous workers [12, 13, 14, 15, 16, 17] have reported not one angle of contact with a particular system, but two angles, an advancing and receding angle. One angle is obtained when water has advanced over a surface and the other when water has receded from the surface. This difference in contact angle is often called the hysteresis of the contact angle. The cause of the hysteresis is still not clearly understood. Recently, Harkins [18, 19], working with hydrophobic materials and an improved method of measuring contact angles, found no hysteresis. Langmuir [17] suggests that the hysteresis of contact angles, especially with water, is due to the presence of a surface layer of molecules with one end hydrophylic and the other hydrophobic, which are overturned by the receding water.

From the above considerations of the variables involved in water repellency, one would expect that a fabric having a high contact angle would be a water repellent fabric. In such cases the water level will remain well outside the surface as shown in figure 3 A. At this point it looks as though we may be able to write a prescription for the optimum conditions for water repellency, viz, a textile fabric in which each fiber is completely coated with the material having the highest solid/water angle of contact. It is unfortunate that this prescription has never been tested. The reason for this is that the present methods of treating fabrics for water repellency do not guarantee the complete coating of each individual fiber. These treatments leave many of the intertwined fibers without any surface coating. The presence of hydrophilic surfaces in the treated fabric will of course greatly diminish the overall resistance of the fabric to wetting.

III. Survey of the Methods Used for Measuring Water Repellency in Fabrics

The number of test methods devised for measuring water repellency appear to be almost as many as the number of laboratories engaged in this field. Comparative data from and references to the vari-

TABLE 1—Methods and testing conditions used by various laboratories in measuring water-repellent properties of textile fabrics

Reference	Name of Test	Year of Reference	Test Temperature	Sample Size	Result Units	Extent of Use
			CLASS A. TEST			
21	Hydrostatic Pressure	1941	80° ± 1° F.	3" x 3"	cm.	Wide, ASTM & AATCC
22	Suter Hydrostatic Pressure	1940	80° ± 1° F.	4" x 4"	cm.	Fed. Spec. CCC-T-191a and Supplement
23	Mullen (High Pressure Range)	1944	?*	4" x 4"	lb/in.²	Fed. Spec. CCC-T-191a and Supplement
24	Box Test for Waterproofness	1936	?	4½ x 20"	ml/min.	Limited
25	British (DSIR)	1925	?	4.8 cm²	cm.	Obsolete
			CLASS B TEST			
26	AATCC Spray	1941	80° ± 1° F.	7" x 7"	gm, %	Very wide, AATCC, Fed. Spec. CCC-T-191a and Supplement
27	Drop Penetration	1944	80° ± 1° F.	8" x 9"	min.	Fed. Spec. CCC-T-191a and Supplement
28	Water Penetration (Drip)	1943	?	4" x 4"	sec.	ASTM
29	Bundesmann	1935	?	154 cm²	ml	British Specs., Germany
30	Impact Penetration	1943	80° ± 1° F.	6" x 8"	gm.	———
31	Spray Test	1937	?	6" x 6"	gm, %	Limited
32	Kern	1933	?	4 cm²	"No. of Drops"	Limited
33	Franz and Henning	1936	?	12 x 26 cm	gm, %	Germany
34	Official German Rain	1910	?	28 x 38 cm	gm, %	Germany
35	Spray Penetration	1946	12° ± 2° C.	12" x 12"	ml	Navy U. S.
			CLASS C TEST			
36	Immersion	1941	80° ± 1° F.	3" x 3"	gm, %	Wide, AATCC, Fed. Spec. CCC-T-191a and Supplement
37	ASTM Water Absorption (Spray) Method.	1943	?	8" x 8"	gm, %	ASTM
38	Dynamic Absorption	1944	80° ± 1° F.	8" x 8"	gm, %	Fed. Spec. CCC-T-191a and Supplement
39	Bundesmann	1935	?	154 cm²	gm, %	British Specs., Germany
40	Becker Submersion Method	1935	Room Temp.	5 x 75 cm	gm, %	Germany
41	Esslinger Submersion Method	1940	?	15 x 5 cm	gm, %	Germany
			CLASS D TEST			
42	Contact Angle by Tensiometer	1945	25° C.	0.196 in	deg.	Experimental
43	Wetting Test	1945	?	Single Yarn	sec.	Experimental
44	Wenzel's Method	1936	?	1" x 3"	deg.	Experimental

* Interrogation mark signifies temperature not indicated.

ous reports on laboratory test methods have been assembled in Table 1. The object of most of these tests has been to offer a sensitive and accurate method of predicting the relative performance of fabrics in the rain. Very few, if any, of the published papers, however, have furnished any data showing the correlation between the particular test method and the performance of fabrics in the rain. Examination of the literature reveals that there is a considerable variation in the methods of testing and the interpretation of the results. It was found convenient for the purpose of this report to arrange the different test method in four general classes:

Class A. Method by which the hydrostatic pressure required to force water through a fabric is measured.

Class B. Methods by which surface wetting and penetration under the influence of falling drops is measured.

Class C. Methods by which the absorption of water by the fabric, when immersed or manipulated under water, is measured.

Class D. Methods by which the wettability of the surface of the fabric is measured by means of the angle of contact or some function of the angle of contact.

Below are given some timely comments about the more popular test methods in each group.

Class A. In this class of test methods, the fabric is subjected to the action of water under pressure by a variety of means. Either the amount of water penetrating in a specified time or the pressure required to force water through the fabric is measured. The most widely used test methods in this class are the AATCC [21] and the Suter [22] hydrostatic pressure tests. Both methods give reproducible test values. It has been reported [45] that a correlation exists between the two methods. The following relationship is supposed to hold at 27 ± 3° C:

$$A = 1.32\,S - 4 \qquad (11)$$

where A = the AATCC test value
S = the Suter test value

The hydrostatic pressure test values are dependent mainly on the pore size and the angle contact. The bulge which occurs when the pressure is applied on the fabric requires a correction [46], but in view of the reproducibility of the test and the smallness of the correction factor, the extra measurements and calculations are usually avoided.

Class B. The tests in this class are in some cases very different from each other. They are all, moreover, quite different from those in Class A. All of the tests in this class subject the test fabric to the action of water drops. The number, size, frequency, and energy of the drops in the various tests vary considerably. The advantages and disadvantages of these various tests are briefly discussed below:

1. The AATCC Spray Test. This test is very widely used in the textile industry for control work. The test will distinguish qualitatively between treated and untreated fabrics. It is not able, however, to distinguish between obviously different water repellent finishes or to predict the performance of a fabric in the rain.

2. The Drop Penetration Test. This test was developed for and used by the U. S. Quartermaster Corps during the war. The energy of the drops used in this apparatus is approximately 10,000-15,000 ergs. This value is much larger than that of the drops in a cloudburst (3000 ergs). It appears that by this test one may be able to arrange fabrics in what seems to be a proper order of protection in the rain. The hardness of the fabric backing has a profound influence on the test value. This is probably true also for the other tests in this group. It should be mentioned that the values obtained in the drop penetration test may differ as much as 20 per cent among each other, depending on the particular fabric and its test value.

3. The Bundesmann Test. The Bundesmann test was developed in Germany. It can be used in two ways: one, to measure the amount of water penetrating the sample; two, to measure the amount of water absorbed by the sample in a given time. Again the drops of water in the test have energy of from 15,000-30,000 ergs, which is a much larger value than is found in a cloudburst. In this procedure the sample of cloth is in constant motion and is continuously rubbed on the under side during the test. When the amount of water absorbed is measured, the mean deviation [33] of the test value is reported to be about 3 percent. The method seems to offer some advantages over the other tests in Class B and has been recently adopted by the British Sub-Committee of the General Technical Committee as a standard test method.

4. The Impact Penetration Test. This test involves the spraying of 500 cc. of water on the test specimen. At the end of the spray period, a blotter beneath the fabric is weighed. The increase in weight of the blotter represents the amount of water which passed through the cloth. No data are available on correlation with natural rain.

5. Spray Test. No temperature control is specified in this test. It appears to be similar to the impact penetration test. No data are available for correlating the results of the test with results obtained with fabrics in natural rain.

6. Kern Test. This novel method has been patented. It employs a single drop of water of definite size. An electrical circuit is used to detect the penetration of the water to the under side of the test specimen. The average deviation of the test value from the mean appears to be smaller for smaller size drops. Although there appears to be a tremendous variation in the results, depending upon the fabric, the author states that seven tests are sufficient for obtaining "exact results."

Class C. All methods in this group measure the resistance which the finish offers to wetting by water. Since droplet penetration is not used in these methods, the part played by the structure of the fabric is less important than in other tests in determining the test value. The water absorbed by the fabric is measured by weighing the test specimen after some form of partial drying. In some of the tests (Dynamic Absorption, Becker, etc.), the sample is in motion during the test period of exposure to the water. In almost all cases the deviation of any particular test value from the mean appears to become smaller as the exposure time gets larger. The dynamic types of tests are definitely to be preferred to the static types in this category. Again, it should be pointed out that little, if any, work has been done to correlate these test results with the performance of fabrics in the rain.

Class D. Workers who have used the following three techniques have done so in an attempt to understand the mechanism of wetting. Various methods for measuring contact angles [47] have been described. The three methods which have been applied to fabrics are discussed below.

1. Wenzel's Method. Wenzel appears to have been the first to attempt to apply methods of measuring contact angles to fabric [10]. He modified the tilting plate method [47] to make it applicable to fabrics. Wenzel measured the contact angle of many materials, waxes, cellulose acetate, many metal stearates, rosin, and others. His data indicated that the method was applicable to textile surfaces and was very reproducible. In this laboratory it was found possible to reproduce the values which Wenzel obtained on paraffin wax on glass. It was found, however, that this method lacked control over the following variables:

a. temperature
b. rate of flow of the water over the solid surface
c. rate of rotation of the plate in the water
d. cleanliness of the surface of the liquid.

2. Wetting Test. This test measures the time for the contact angle on a yarn or strip of fabric to decrease to 90°. This time has been called the "wetting time." Cassie and Baxter claim that the wetting test is more sensitive to proofing efficiency than either the Bundesmann or

the hydrostatic pressure tests.

3. Contact Angle by the Tensiometer Method. Wakeham and Skau [42] found that, by modifying an ordinary interfacial tensiometer and forcing a circular piece of fabric through the surface of the water, they obtained a relationship between the pressure necessary to force the disk of cloth through the surface of the water and the angle of contact of the water to fabric. The method does not appear to be capable of measuring angles greater than 120°. Unfortunately, the upper portion of the measurable range is the most useful from the point of view of water repellency.

The great dependence of all test values on the temperature of the water has been mentioned in several reports [43, 45, 33, 48]. It is quite surprising, therefore, that many of the methods listed in table 1 appeared to be uncontrolled in temperature.

The above review of the methods used to measure water repellency indicates that no one method completely measures the phenomenon. It appears necessary that a combination of tests be used to evaluate the water repellency of a fabric. It appears possible, also, to select one test from each class and report the results in the same units. For example, the hydrostatic pressure is increased at the rate of 1.0 cm. per second in the AATCC test. The test value could be expressed in time units. This could also be done with the drop penetration, the dynamic absorption, the wetting and other tests. One could then obtain a summary test value which would be the results of "n" number of test values, all expressed in time units:

$$T = f(a, b, c, \text{———} n) \qquad (12)$$

It seems reasonable to assume that the value derived from "n" number of tests would be a more reliable measure of the repellency of a fabric than taking the value of only one test. It would remain to be proven, however, whether such a summary value gives an accurate and reliable indication of the performance of a fabric in the rain.

Considerable information obtained during the war indicates that many of the test methods given in Table 1 are not applicable for evaluating the repellency of woolen fabrics [49]. All of the test methods mentioned require further investigation to see whether they can be adapted for testing all types of water repellent fabrics. It is also necessary that some of the methods be studied for the purpose of setting up commercial and government standard methods of testing.

IV. The Evaluation of Water Repellency by Typical Test Methods

In planning the laboratory work, it was necessary to take into account the questions which are asked by government agencies, industry, and the public at large. The following general questions are frequently asked:

a. To what degree is a particular fabric water repellent?
b. To what extent does dry cleaning and/or laundering diminish the water repellency of a fabric?
c. What causes a fabric to lose its repellency during the course of exposure to the rain?

In order to have available a background of information and data about water repellent fabrics and common test methods, eleven typical commercial raincoat fabrics and four Army fabrics were selected for study. The characteristics of these 15 water repellent fabrics are given in Tables 2 and 3. The water repellent properties were examined by the following four test methods:

1. The AATCC Hydrostatic Pressure Test
2. The AATCC Spray Test
3. The Drop Penetration Test
4. The Angle of Contact Test (Tensiometer Type).

Figure 4a-4d shows the results obtained by the four test methods. Each test was done according to the exact directions prescribed in government specifications or published papers. It is noted that the most widely used of all test methods, the spray rating test, did not show any differences among twelve of the fifteen fabrics. Great differences amongst the various fabrics are revealed by the remaining three tests. Since each test measures different properties of the fabrics (see section III), it is not surprising that the three tests do not rank the fifteen fabrics in exactly the same order. It is noted, however, that all fabrics can be approximately fitted into three general groups: good, fair, and poor. Certain samples always appear in a specific group: e.g. No. 5, poor; No. 3, good; No. 6, fair, etc. The fallacy of using only one

TABLE 2—General properties of eleven water repellent commercial fabrics

Sample No.	Type of Weave	Number of Piles		Thread Count		Air Permeability $Ft^3/min.\ ft^2$ at pressure of 0.5 inch of water across fabric	Weight Oz./yd^2
		Warp	Filling	Warp	Filling		
1	Twill-Tackle	1	3	125	65	20.4	8.6
2	Twill-Tackle	1	3	125	67	17.9	8.9
3	Plain-Poplin	2	1	107	51	5.0	5.8
4	Plain-Poplin	2	1	109	52	6.2	5.9
5	Twill	2	2	135	58	6.4	6.4
6	Plain-Poplin	2	1	107	55	8.0	5.7
7	Plain-Poplin	2	1	107	54	5.0	6.0
8	Twill-Gabardine ...	2	1	127	54	16.2	6.5
9	Plain-Poplin	2	1	106	54	4.6	6.3
10	Twill	1	1	104	60	23.6	7.3
11	Plain-Poplin	2	1	107	56	5.3	6.2

TABLE 3—General Properties of four Army water repellent fabics

Sample No.	Type of Weave	Number of Piles		Thread Count		Air Permeability $Ft^3/min.\ ft^2$ (at a pressure of 0.5 inch of water across fabric)	Weight oz./yd^2
		Warp	Filling	Warp	Filling		
12	Sateen	2	2	115	70	3.9	9.1
15	Oxford Type II...	1	1	134	53	3.2	6.2
24	Sateen	2	2	115	67	3.6	8.9
26	Poplin	1	1	53	52	4.1	6.2

TABLE 4—The effect of dry cleaning and laundering on the water repellency of eleven commercial fabrics

Sample No.	Spray Rating			Hydrostatic Pressure (centimeters of water)			Drop Penetration Time (Time, in minutes, to collect 10 ml. of water)		
	Control	Dry Cleaned 3 times	Laundered 3 times	Control	Dry Cleaned 3 times	Laundered 3 times	Control	Dry Cleaned 3 times	Laundered 3 times
1	100	50	50	28.9	36.3	4.0	1.7	1.6	1.4
2	100	50	0	33.0	29.9	3.3	1.5	1.4	*
3	90	70	0	40.1	18.4	2.9	6.8	*	*
4	100	70	70	35.9	33.1	9.0	4.2	2.3	2.7
5	80	0	0	16.5	2.7	0	2.1	*	*
6	100	50	0	33.1	15.7	2.5	2.4	*	*
7	100	70	80	48.0	40.1	28.2	3.2	3.1	3.4
8	100	70	0	29.5	23.6	0	2.0	1.1	*
9	100	70	50	37.8	32.4	14.9	3.9	2.8	3.2
10	90	0	0	30.5	5.3	2.8	1.6	0.6	*
11	100	70	70	36.3	31.6	31.6	3.9	3.0	4.4

* Drop penetration time could not be measured since the swatches became completely saturated with water at the start of the test.

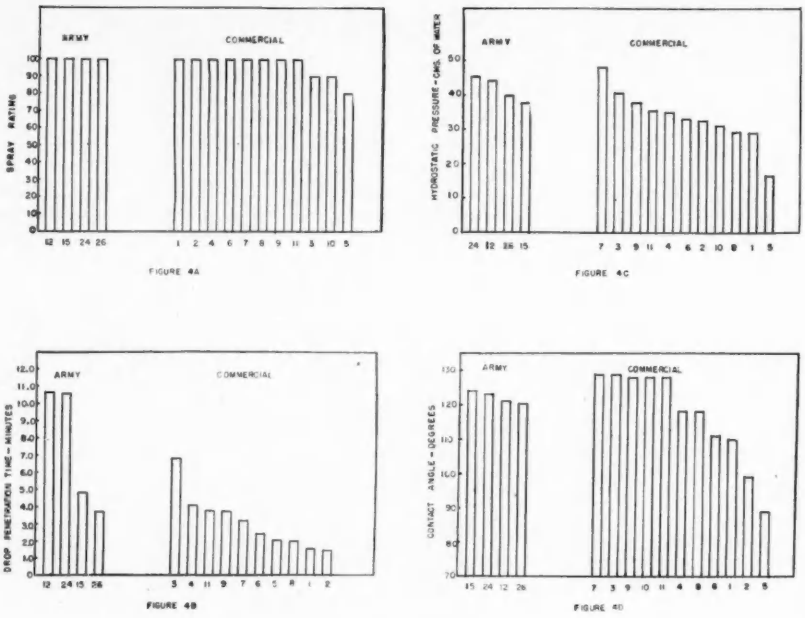

Figure 4. Comparison of Four Water Repellency Tests

test method to evaluate water repellency can be clearly seen from the data presented. It would be quite impossible to classify a particular water repellent fabric using only one test.

Both the hydrostatic pressure test and the measurements on contact angles reveal certain differences among the various samples not revealed by the spray test. The drop penetration test, however, appears to be able to show differences in the fabrics that were not revealed by any of the other tests. The limitations of a particular laboratory test for evaluating water repellency are generally recognized. The most frequent argument against a certain test is that it does not test the fabric under conditions of actual use. Tests which simulate natural rain, therefore, are considered much more useful for practical testing. The drop penetration test appears to be very useful in predicting the relative performance of fabrics in the rain. It seemed desirable, therefore, to study the present group of fabrics in greater detail using this test. In view of the arbitrariness of the test value—the time to collect 10 cc. of water passing through the test specimen—it was decided to study the rate of penetration of water through water repellent fabrics for long periods of exposure time. It was found that the "rate of penetration (ml/min.) vs. time curve" was very characteristic of the nature of the particular fabric. Figures 5 and 6 show plots of the rate of penetration of water against time of exposure, for 11 of the fabrics studied. The arrows in figures 5 and 6 indicate the time at which 10 ml. of water had passed through the fabric. Each rate curve contains the following characteristic portions:

a. an induction period
b. an S-shaped portion of a curve
c. a limiting rate region.

It is believed that the penetration of water through a fabric in natural rain follows a similar pattern and that the curves obtained for the drop penetration apparatus are not a characteristic of the apparatus alone. Examination of these curves reveals that during the induction period little or no water comes through the cloth. When the resistance to penetration is finally broken, water passes through the fabric at a very rapid rate (S-shaped region). Finally the amount of water which penetrates the fabric per unit time reaches a steady state. Since most of the water repellent fabrics tested are at best only somewhat resistant to penetration, it is seen that after prolonged exposure of a water repellent garment to the rain, the wearer would not keep dry. The curves also indicate that the longer the induction period, the lower will be the equilibrium rate of penetration of water. In designing new water repellent fabrics, therefore, the object would be to fix the various variables involved so that the resulting product would have a long induction period and a low rate of penetration. Such a fabric has been designed. The Shirley type cloths which the Army Quartermaster Corps developed during the war have a very long induction period (several hours) and a very low equilibrium rate of penetration (approx. 0.1 ml/min.). These types of fabrics are highly desirable for prolonged use in the rain.

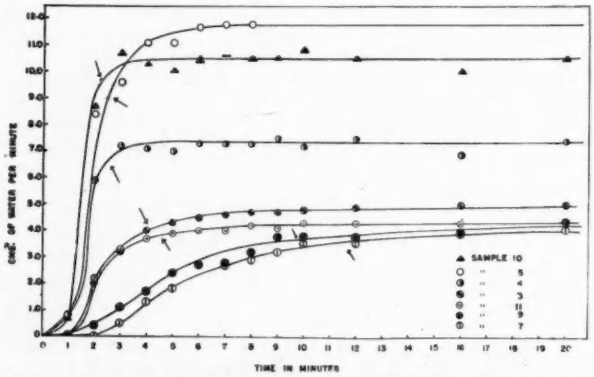

Figure 5. Rate of Penetration of Water Through Fabrics in the Drop Penetration Apparatus. The Arrows Show the Point at Which 10 CMS² of Water—Test Value—Have Passed Through the Fabric

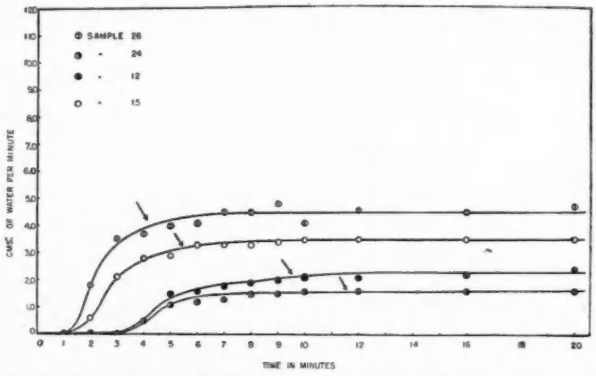

Figure 6. Rates of Penetration of Water Through Fabrics in the Drop Penetration Apparatus. The Arrows Show the Point at Which 10 CMS² of Water—Test Value— Have Passed Through the Fabric

The above studies of water repellency lead to the conclusion that obtaining the rate of penetration of water with the drop penetration apparatus gives a more complete picture of the repellency of a fabric than the 10 cc. test value by itself. This is especially significant when one is considering commercial fabrics (compare fig. 5 with 6). It is also concluded that better evaluation of water repellency may be made when a group of tests is employed. A study of the four test methods given above reveals that, since the rank correlation among various tests is very low, it is necessary to correlate all tests with the behavior of fabrics in natural or artificial rain. The Philadelphia Quartermaster Depot has developed and constructed [50] a rain room for fabric and garment testing. By means of specially designed nozzles, it is possible to obtain rainfalls at the rate of a 0.1, 1.0, and 3.0 inches per hour, having natural and reproducible drop size distributions.

V. The Durability of Water Repellency Finishes

The durability of water repellent finishes is generally taken to be the resistance which the finish shows to the action of dry cleaning or laundering. Durable water repellent fabrics are those whose water repellency is only slightly diminished by dry cleaning or laundering. Those fabrics whose water repellency is totally or greatly impaired by dry cleaning or laundering are classified as being non-durable. It is to be remembered that the two terms are only relative and that the difference beween them is a matter of degree of resistance and not necessarily of type of compound.

The effect of dry cleaning and laundering on water repellency was studied, using only the eleven commercial raincoat fabrics given in Table 2. Standard methods of dry cleaning and laundering were used [51]. The results of these studies are given in Table 4. By the use of three different test methods, it was found possible to distinguish between durable and non-durable repellent finishes. The samples, 4, 7, 9, 11, show a smaller decrease in all test values, than do the remaining samples which reveal fairly large changes in all test values. It was found that samples whose water repellency had been totally lost by dry cleaning or laundering, gave no test value in the drop penetration test. These samples became completely saturated with water as soon as they were placed in the test apparatus.

The lowering of the water repellency of fabrics by dry cleaning or laundering is commonly attributed to leaching of the repellent compound. The presence of residual soap on the fabric and distortions of the fabric structure are also considered responsible for the loss in repellency. It has been observed, however, that simple wetting by water will also decrease the repellency of a fabric. Tests done at the Philadelphia Quartermaster Depot [52] have shown that water repellent jackets were more easily wetted if they had been previously exposed to the rain. It was found that drying the jackets after the test exposure, even by heating in an oven, failed to restore to the garments their original water repellency. In view of the interest in the durability of water repellency, it seemed advisable to attempt to establish the rate at which some fabrics lose their repellency when exposed to the rain. For this study, four swatches each, of five different water repellent fabrics, were tested five different days in the drop penetration test. At the end of each test period, the swatches were allowed to dry at room temperature and then were conditioned overnight at 65 percent relative humidity and 70° F. The results of this experiment are shown in Figure 7. It was found that the various fabrics lose their repellency at different rates. The drop penetration test values get progressively lower each time the swatches are tested. This loss in repellency appears to be an irreversible process. Attempts to restore the original repellency by heating in vacuo at elevated temperatures were unsuccessful. An analysis of the factors which could be causing the loss of repellency leads to the following:

a. Loss in the repellent agent by leaching
b. Creation of new uncoated surfaces due to swelling of fibers
c. Changes in the surface geometry of the fabric due to the pounding of the high energy drops.

Any or all of the above changes could be taking place, and they all would be irreversible changes.

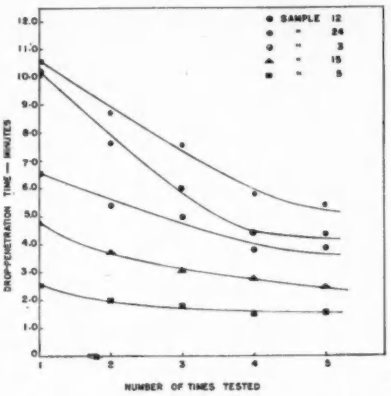

Figure 7. Lowering of the Drop Penetration Time Due to Repeated Testing

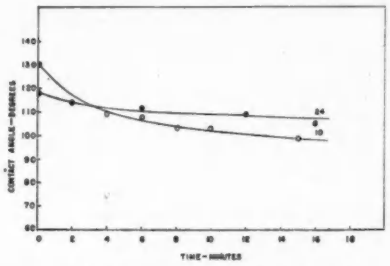

Figure 8. Change in Contact Angle of Fabrics Exposed in the Drop Penetration Apparatus

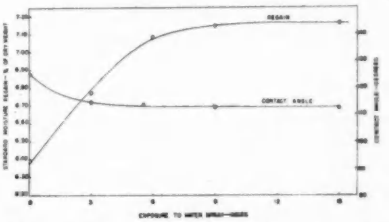

Figure 9. Changes in the Contact Angle and the Standard Moisture Regain of a 9 oz. Water Repellent Fabric After Prolonged Spraying with Water

In order to throw light on the loss in repellency, two simple exploratory experiments were made. The changes in the contact angle of two of the fabrics were measured after various periods of wetting in the drop penetration apparatus. Also, the change in contact angle and the increase in "standard moisture regain"[2] of one sample were noted after prolonged periods of spraying. The spraying was done with the nozzle of the AATCC spray test and was continuous for the particular period of time. The results of these observations are shown in figures 8 and 9. The contact angle of the dry fabrics was found to be lower after each period of wetting in the drop penetration test. The contact angle of one of the fabrics was also lowered after spraying the sample for various times. Swatches of this fabric, when sprayed and then tested for standard moisture regain, showed an increase in rate of moisture absorption. It is emphasized that the increase is an increase in rate (per 24-hour period) since the "repellent" fabrics do not always reach equilibrium in this length of time.

It will be recalled from section II that the contact angle is influenced by the following factors: the chemical nature of the solid surface, the porosity of the surface, and the presence of other molecules on the surface. Again, any one or all of these factors could diminish the contact angle during wetting of the fabric. The change in moisture regain

[2] Regain in weight during a 24-hour exposure period to 65 percent relative humidity and 70° F.

of sample 24 (fig. 9) shows that the rate at which a fabric absorbs moisture increases in proportion to the number of times the sample has been wetted. It is of interest to examine the surface factors which might be responsible for the increase in moisture absorption. The loss in repellent agent, the change in the positions of the fibers in the yarns, and the creation of new surfaces could all affect the rate of water absorption. The swelling of partially coated or uncoated fibers would also result in making available more hydrophilic surfaces (OH groups) [53].

VI. Summary and Conclusions

The theory of water repellency of textile fabrics has been reviewed with special references to the more recent theories of the penetration of water through fabrics. A survey has also been made on the various testing methods which have been devised for measuring water repellency. The results of the present investigation lead to the following conclusions regarding the status of water repellency. There is definite need for a comprehensive study of the role which the structure of a fabric plays in the phenomena of water repellency. In the past, the emphasis has been on developing more efficient compounds. Data available indicate that a better understanding of the physics of fabric construction as it applies to repellency, coupled with the now available water repellent agents, will lead to some more nearly idealized type of water repellent garment. In regard to testing methods, it is required that correlation be established between the results of laboratory test methods and performance of fabrics in the rain.

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MISCELLANEOUS

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• British Reports Available

The textile printing methods of major German firms and the wet processing of synthetic fibers by I. G. Farbenindustrie at Hoechst, Germany, are described in two British reports now on sale by the Office of Technical Services, Department of Commerce. Both reports were prepared by investigators for the British Intelligence Objectives Sub-Committee.

Orders for the reports (PB-65676; *Textile Printing in Germany;* photostat $3; microfilm $1; 45 pages) (PB-69122; *German Synthetic Fibers—Wet Processing* photostat, $2; microfilm $1; 17 pages) may be addressed to the Office of Technical Services, Department of Commerce, Washington 25, D. C., accompanied by check or money order, payable to the Treasurer of the United States.

Mimeographed copies of both reports (PB-65676, $2.50; PB-69122, $1.75) may be obtained from the Hobart Publishing Company, Box 4127, Chevy Chase Branch, Washington 15, D. C.

The Resistance of Treated Felt Gasket Materials to Fungus Attack

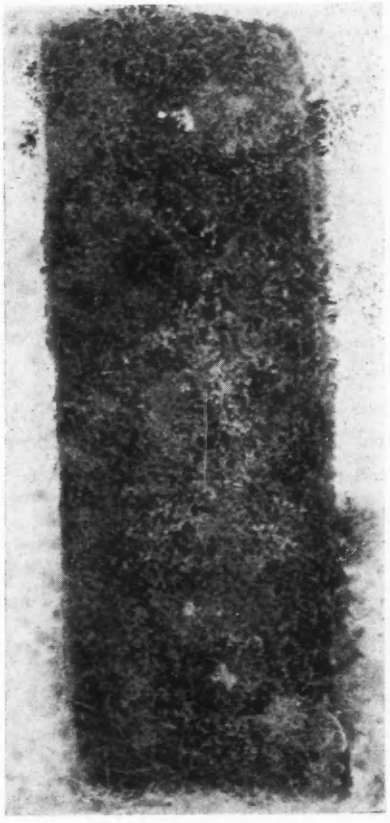
SIGMUND BERK
Frankford Arsenal, Philadelphia, Pa.

FELT gasket materials are subject to deterioration by microorganisms when exposed in tropical areas or stored in temperate regions under favorable conditions of temperature and humidity. Since felt is manufactured by matting together fibrous materials, such as wool, cotton, hair, and other textile fibers, its susceptibility to attack by bacteria and fungi is dependent on its composition. One hundred per cent wool felt is resistant or only slightly subject to attack by molds; any fungus growth that does occur has been attributed to the presence of soaps, vegetable oils, and conditioning agents used in the manufacture of the material. Wool is much more susceptible to attack by bacteria than by fungi and since the former require higher percentages of moisture for their development than fungi, severe deterioration will not occur unless the felt remains wet for extended periods of time. However, the addition of cotton fibers to wool felts, increases markedly the susceptibility of the material to mold growth. To eliminate the growth of fungi on felt used in ordnance equipment, the Ordnance Department of the U. S. Army provides that wool felt should be treated with dihydroxydichlorodiphenyl methane or salicylanilide.[1]

Under the auspices of the Society of Automotive Engineers, a committee consisting of representatives of the various military services and manufacturers of automotive, gasket, and fungicidal materials was set up to study methods of fungus-proofing automotive gasket materials. Frankford Arsenal was authorized to conduct mold resistance tests on the samples submitted by various organizations. The results given in this report are concerned solely with felt gaskets treated with seven fungicides.

Method Used to Test Mold Resistance

The samples of untreated and treated felt were cut into strips approximately 1 by 3 inches. Two methods of incubation were used. In Test A, the felt sample was suspended from the metal top of one-quart Mason jars containing a one-half inch of water. The felt was wetted by dipping into distilled water. Inoculation was effected by dusting the lower portion of each sample with spores from one of the three test organisms used (*Aspergillus niger, TC #215-4247; Chaetomium globosum, U. S. D. A. #1042.4;* and *Penicillium sp., U. S. D. A. #1336.2*). The inoculum was obtained by gently stroking with a camel's hair brush the sporulating surface of a pure culture of the test organism growing on mineral salts dextrose agar in Petri dishes. By screwing the metal top on the jar and storing at a temperature of 85°F., (29.4 C.), each container became an incubation chamber maintained at saturated moisture conditions. This test tends to approximate the type of storage conditions that would be encountered in the tropics. Although conditions of 100 per cent relative humidity are quite prevalent under tropical exposures, this test is somewhat more severe, since the jars maintained a condition of stagnant air saturated with moisture.



Mag. 1.5X

Figure 1—Growth of a species of Penicillium on untreated felt incubated in a Petri dish on mineral salts dextrose agar (sample No. 149).

In Test B, the unsterilized specimens of felt were placed on 20 ml. of sterilized and solidified mineral salts dextrose agar contained in Petri plates. The felt strips were inoculated as in Test A and incubated in a constant temperature room at 85°F. and a relative humidity above 80 per cent. This test was used to determine the effectiveness of the fungicides when the treated material was incubated on a medium that provides a good source of food for fungus growth.

Two to five replicates were used for each organism in both tests. After a two week incubation period, the felt strips were examined and rated for extent of mold growth (Table I).

Evaluation of Fungicide Treatments

Table I shows the fungus growth on felt samples treated with a number of chemical protectants. Complete protection against mold attack by the three test organisms was provided by the following fungicides: 0.25 per cent phenyl mercuric oleate, two per cent ethyl mercuric pentachlorophenolate, ten per cent zinc dimethyldithiocarbamate, four per cent copper pentachlorophenate, and one to 1.5 per cent dihydroxydichlorodiphenyl methane. Only the 100 per cent wool felt treated wtih these concentrations of dihydroxydichlorodiphenyl methane gave complete protection against fungus growth. This fungicide is substantive to wool but not to cotton.

A number of chemical treatments showed only slight mold growth with one or more test organisms and these may be considered as satisfactory. Two per cent copper 8-hydroxyquinoline with and without a water repellent showed good resistance against mold growth. The results of mold tests with this fungicide agree

[1] Wool Felt; Treatments for Mildew-Proofing and Moisture-Proofing. Ornance Department, U. S. Army Tentative Specifications AXS-1475, January 1945.

TABLE I

Resistance of Chemically Treated Felt Gaskets to Three Species of Fungi

Test A—Incubated over Water in Mason Jars
Test B—Incubated on Solidified Mineral Salts Dextrose Agar in Petri Dishes

Code for Fungus Growth:

— = No Growth
+ = Slight Growth
++ = Moderate Growth Over Part of Sample
+++ = Moderate Growth Over Entire Sample
++++ = Heavy Growth Over Entire Sample

Sample No.	Type of Felt	Fungicide or Chemical Protectant	% Fungicide in Treating bath	Test	Test Organisms: Aspergillus niger	Chaetomium globosum	Penicillium sp.
*127	S.A.E. F-1	Untreated		A	++	++	++
				B	++++	++++	++
*138	S.A.E. F-1	Phenylmercuric salt or oleyl-amido-ethane-sulfonic acid	—	A	+	+	+
				B	+	+	+
*139	S.A.E. F-3	Untreated		A	++++	++++	+++
				B	+++	+++	+++
*140	S.A.E. F-3	Phenylmercuric salt or oleyl-amido-ethane-sulfonic acid	—	A	+	++	++
				B	++	++	++
*141	S.A.E. F-3 Surface laminated with Sheet Hycar	Untreated		A	++++	++++	++++
				B	+++	+++	+++
*142	S.A.E. F-3 Surface laminated with Sheet Hycar	Phenylmercuric salt of oleyl-amido-ethane-sulfonic acid	—	A	—	—	+
				B	+	+	+
*143	S.A.E. F-15	Untreated		A	++	++	+
				B	+++	++	++
*144	S.A.E. F-15	Phenylmercuric salt of oleyl-amido-ethane-sulfonic acid	—	A	++	++	++
				B	++	++	++
*145	S.A.E. F-15	Copper 8-Hydroxyquinoline	2.0	A	—	—	+
				B	—	—	—
*146	S.A.E. F-15	Copper 8-Hydroxyquinoline + Water Repellent	2.0	A	+	+	+
				B	—	—	—
149	9110G	Untreated		A	+++	++	+++
				B	++++	++++	++++
150	9110G	Zinc dimethyldithiocarbamate	2.0	A	—	—	—
				B	—	—	+
152	9110G	Phenyl mercuric oleate	0.25	A	—	—	—
				B	—	—	—
153	9110G	Ethyl mercuric pentachlorophenolate	2.0	A	—	—	—
				B	—	—	—
154	9110G	Zinc dimethyldithiocarbamate	5.0	A	—	—	—
				B	—	—	+
155	9110G	Zinc dimethyldithiocarbamate	10.0	A	—	—	—
				B	—	—	—
*157	9110G	Copper 8-hydroxyquinoline (2 bath)	2.0	A	—	+	+
				B	—	—	—
*158	9110G	Copper 8-hydroxyquinoline plus Water Repellent	2.0	A	—	—	+
				B	—	—	—
*159	9110G	Copper 8-hydroxyquinoline (1 bath)	2.0	A	—	+	+
				B	—	—	—
*160	50-50% Wool-Cotton	Dihydroxydichlorodiphenyl methane	1.5	A	+	+	+
				B	+	+++	++
*161	50-50% Wool-Cotton	Dihydroxydichlorodiphenyl methane	1.0	A	—	+	+
				B	—	+	+
*162	50-50% Wool-Cotton	Dihydroxydichlorodiphenyl methane	0.7	A	—	+	+
				B	++	+	++
*163	60-40% Wool-Cotton	Dihydroxydichlorodiphenyl methane	1.5	A	+	+	+
				B	+	+	+++
*164	60-40% Wool-Cotton	Dihydroxydichlorodiphenyl methane	1.0	A	+	+	—
				B	—	—	+
*165	60-40% Wool-Cotton	Dihydroxydichlorodiphenyl methane	0.7	A	++	++	+
				B	+	+	++
*166	80-20% Wool-Cotton	Dihydroxydichlorodiphenyl methane	1.5	A	—	Not tested	+
				B	—	—	—
*167	80-20% Wool-Cotton	Dihydroxydichlorodiphenyl methane	1.0	A	—	+	+
				B	—	+	++++
*168	80-20% Wool-Cotton	Dihydroxydichlorodiphenyl methane	0.75	A	—	+	—
				B	—	+	+
*169	100% Wool	Dihydroxydichlorodiphenyl methane	1.5	A	—	—	—
				B	—	—	—
*170	100% Wool	Dihydroxydichlorodiphenyl methane	1.0	A	—	—	—
				B	—	—	—
*171	100% Wool	Dihydroxydichlorodiphenyl methane	0.75	A	—	—	—
				B	++	—	+
*173	———	Copper pentachlorophenate	4.0	A	—	—	—
				B	—	—	—

* Samples conditioned at 100° F. ± 2° F. and 30 percent relative humidity for 30 days prior to fungus tests.

with the work of Benignus and Rogers.[2]

Two to five per cent zinc dimethyldithiocarbamate showed only slight growth with the species of *Penicillium* in Test B. Dihydroxydichlorodiphenyl methane in concentrations of 0.75, one, and 1.75 per cent gave satisfactory protection to some of the cotton-wool mixtures. Of the seven fungicides tested, the phenyl mercuric salt of oleyl-amido-ethane-sulfonic acid was the least effective in imparting mold resistance to felt.

[2] Benignus, P. G. and Rogers, D. F. 1945. "Mildew-Proofing Automotive Gaskets Materials," Monsanto Chemical Co.

Summary

The effectiveness against mold growth of felt gasket materials treated with seven fungicides has been determined.

Complete protection against fungus growth was shown by copper pentachlorophenate, phenyl mercuric oleate, ethyl mercuric pentachlorophenolate and zinc dimethyldithiocarbamate. Dihydroxydichlorodiphenyl methane in concentrations of 1 and 1.5 per cent gave complete protection to 100 per cent wool felts but only partial protection to cotton-wool felt mixtures. Copper 8-hydroxyquinoline with and without an added water repellent showed only slight growth and is considered satisfactory. The phenyl mercuric salt of oleyl-amido-ethane-sulfonic acid was the least effective of the fungicides tested.

Acknowledgment

The author is indebted to the Office, Chief of Ordnance, War Department and Messrs. C. C. Fawcett, E. R. Rechel, M. Frager and L. Teitell of the Ordnance Laboratory, Frankford Arsenal, for making possible this study.

TRADE NOTES • NEW PRODUCTS

• General Releases

General Dyestuff Corp., 435 Hudson Street, New York 14, N. Y., has announced the release of circulars describing the following products:

Rapidogen Blue R*—(Patented)—a stable azoic preparation, soluble in alkali which, after printing and acid ageing, develops in the form of an insoluble pigment said to possess good fastness properties. When printed on cotton or rayon fabrics it produces bright reddish-blue shades said to possess good fastness to wahing, light and chlorine.

It is applied in the usual manner for Rapidogen colors. It is stated that the stability in the print paste is good and the shade develops completely in acid ageing.

When dissolved with Developer Base RPN in place of caustic soda it develops satisfactorily in neutral ageing and may be printed alongside vat colors. The neutral developing method has the additional advantage of producing smoother prints on rayon fabrics than the conventional caustic soda method. Circular G-472.

Chromindigen Blue BRA Conc. CF*—a new homogeneous chrome dyestuff which is said to yield exceptionally bloomy shades of navy blue with very good fastness properties.

Shades obtained when dyed either topchromed or on a chrome bottom are said to resemble indigo dyed wool.

Because of its good solubility and level dyeing properties it can be used for machine dyeing of raw stock, slubbing and yarn and is suitable for application on piece goods. The dyeings obtained are said to possess very good fastness to light, washing, fulling, carbonizing and perspiration. Circular G-483.

Rapidogen Bordeaux RN*—(Patented)—a stable azoic dyestuff soluble in alkali, which after printing and developing in acid or vat ageing, develops in the form of an insoluble pigment, said to possess good fastness properties. It is primarily intended for application printing on cotton and rayon, yielding bright bordeaux shades. It dissolves readily with alkali and has good stability in the print paste. An addition of neutral chromate to the print paste is recommended.

The prints can be developed by the conventional acid ageing, or if caustic soda is replaced by Developer Base RPN in dissolving, they can also be developed by neutral ageing. The product, therefore, can be printed alongside vat colors. The neutral developing method produces smoother prints on rayon fabrics. Circular G-484.

Rapid Fast Brown IRH Powder—(Patented)—a stable azoic compound, soluble in alkali, which, after printing and developing in acid or vat ageing, develops in the form of an insoluble pigment said to possess superior fastness properties.

It yields pleasing reddish brown shades said to possess excellent fastness to light and very good fastness to washing and chlorine.

It is pasted up with Cellosolve, caustic soda and neutral chromate solution and thickened with starch-tragacanth. The pastes are said to possess good stability.

It is equally suitable for direct printing on both cotton and rayon and can be developed fully in either acid ageing or ordinary vat ageing. Circular G-486.

Palatine Fast Blue 5RNA-CF—a metallized acid dyestuff which is said to possess fastness properties closely approaching those of the chrome colors. It is stated that, due to its very good level dyeing and fastness properties and its easy method of application, it is well suited for the dyeing of fast-to-wear shades on better types of ladies' and men's wear. It can be used on piece goods, knitting, hosiery, carpet yarns, etc., and loose wool and slubbing which are to be given a light fulling. It can be discharged white with Rongalite C and is suitable for use on materials which are to be rubberized after dyeing. Circular G-487.

Coveral AS—an essential oil said to possess very powerful deodorizing properties. It is claimed that as little as 0.1% will neutralize or pleasantly mask most of the obnoxious odors that are liable to develop on textile fabrics. It is compatible with most of the finishing compounds such as sulfonated oils, starches, gums, waxes, urea formaldehyde, etc.; and, as it is stable to drying at high temperatures, can be applied as an addition in the final finishing operation to neutralize or mask any objectionable odors that are present or may develop. It may also be applied separately by spraying, padding, or in the final rinse water. Circular GDC-276.

Nekal NF*—(Patented)—recommended especially by the manufacturers as a wetting assistant in the application of reduced vat dyestuffs by the padding process and, it is claimed, has been very favorably received by the trade due to its excellent wetting and outstandingly good non-foaming properties. It is stated that it is also an excellent assistant in scouring, pasting of dyestuffs and leveling and penetrating of dyeings. Circular G-480.

Eulysine A in the Textile Industry—said to possess good wetting property. It is recommended especially by the manufacturers for dyeing sulfur colors to eliminate or greatly minimize bronziness, also as an addition to crabbing liquor with marked improvement in the subsequent scouring operation. It is stated that it does not impair wool fiber, even at boiling temperature. It may be used in conjunction with such products as Leonil SA, Nekal BX, Monopol Brilliant Oil, Prestabit Oil, etc. Circular G-488.

* Reg. U. S. Pat. Off.

• Join National Starch

Morgan Potts and J. Harvey Kisling have joined the New York sales staff of National Starch Products Inc. and its National Adhesives Division, with headquarters in New York City.

• Appointed Dean, L. T. I.

President Kenneth R. Fox of the Lowell Textile Institute has announced the appointment of Dr. Simon Williams of New York City to the newly-created post of Dean of the Institute.

Coming to the Institute with a wealth of experience in the field of textile education, research, and manufacturing, Dr. Williams will assist President Fox in the administration of the student body and faculty. The creation of the new post was made necessary by the steady expansion of

the Institute which will have nearly 600 students when classes resume this fall.

Dr. Williams received his B.S. degree from the New York State College of Forestry, Syracuse, New York and his master's degree from the University of Washington. In 1939 he was awarded his Ph.D. from the New York State College of Forestry where he served as a teaching fellow during his last three years.

From 1940 to 1944 he was Assistant Professor from the Bureau of Industrial Chemistry at the University of Texas, on the Graduate School faculty. From 1944 to 1946, Dr. Williams was Director of Research for the National Cotton Council of America, Memphis, Tennessee where he had charge of the activities of one of the largest wartime cotton research groups in the country.

In 1946 he became Associate Director of Research for Fabric Research Laboratories, Inc. of Boston, Massachusetts.

Since 1946 he has been Associate Professor at Farragut College and Technical Institute, Farragut, Idaho while on leave of absence from Fabric Research Laboratories.

Dr. Williams has numerous technical papers to his credit and is a member of Board of Reviewers for Matthews' "Textile Fibers" as well as a member of the Advisory Committee on abrasion resistance of textiles for the U. S. Army Quartermaster, and co-ordinator of an industry-wide research program on the use of cotton fabrics in plastic laminates.

His professional societies include Sigma Xi, Phi Kappa Phi, American Chemical Society, Society of Plastic Engineers, Society of American Foresters, Fiber Society, American Association of Textile Chemists and Colorists, American Association for the Advancement of Science and American Society for Testing Materials.

• Join Arnold, Hoffman

Arnold, Hoffman & Co. Incorporated of Providence, Rhode Island announce

Richard C. Dowling

Harold C. Wood

two recent additions to their sales staff. Richard C. Dowling and Harold C. Wood joined the firm on August 1, 1947.

Mr. Dowling will be attached to the company's Philadelphia office. He has had a broad technical experience having been for seventeen years in the Organic Chemicals Division of E. I. duPont de Nemours & Co. and more recently with several important textile mill operations.

Mr. Wood, who will have headquarters in the Boston office, is a Philadelphia Textile School graduate. He was, for a time, with Farr Alpaca Company and for the past ten years has had a wide selling and demonstration experience in the New England territory where he has many friends.

Mr. Wood is president of the Grand Council of Phi Psi Fraternity.

• Winkle-Resistant Finish

George S. Harris, president of Dan River Mills, Inc., of Danville, Va., disclosed recently the development of a chemical treatment to make cotton goods "wrinkle-resistant."

The wrinkle-resistant finish will create extensive new uses for cotton in the men's and women's clothing apparel field, Mr. Harris stated.

The process was developed after four years of intensive research at Dan River's Danville laboratories. For the last two years, the work was conducted in collaboration with the Monsanto Chemical Company. Basis of the finish is Monsanto's "Resloom," a synthetic resin formula which previously has been applied successfully to woolen fabrics so as to make them washable. The announcement was the first that "Resloom C" had been applied successfully to cotton to achieve a wrinkle-resistant finish.

Mr. Harris said that test runs with several hundred thousands of yards of cotton fabrics were made before a successful method of application was achieved. The tests were made under varying degrees of temperature and tensions. Fabrics tested included cotton cambrays, ginghams, Gordon Plaid shirtings and cotton tweeds.

The official said that not all fabrics had responded alike to the treatment and that development work was still going on to "perfect our methods of application so that the finish can be applied equally successfully to all, or most, types of cotton goods."

He added that commercial production of wrinkle-resistant fabrics was now under way but that it would be "restricted to a very narrow volume" until these technological problems were solved.

• Durable Moire Finish

A durable moire finish which is not affected by water spotting or by wet cleaning by dry cleaners has been developed by the Textile Resin Department of the American Cyanamid Company, it was announced recently. The finish is a thermosetting resin which is heat-cured so that the moire effect becomes permanently a part of the fabric.

The new moire finish is claimed to be so durable that applied to all-rayon or rayon and cotton bengalines it may even be laundered without injuring the moire effect. The finish is also said to impart crease resistance, stabilize the goods against dimensional changes and give a full rich hand to the fabric.

Cyanamid's durable moire finish is applied by passing the goods through a bath containing the thermosetting resins in solution and drying the fabric at a low temperature before embossing. After the moire effect has been applied on the calendar the goods are cured so that the effect becomes permanently a part of the fabric.

• Director of Research, Emery Industries

Appointment of Lt. Col. Robert Van Tuyle as director of research for Emery Industries, Inc., Cincinnati, has been announced by Dr. L. D. Myers, Chemical Director for Emery.

Mr. Van Tuyle was graduated from the University of Cincinnati in 1934 with the degree of chemical engineer. He joined the research laboratories of Emery that year and worked as a research chemist until 1941 when he entered the Chemical Warfare Service, Technical Division of the army. He was released from the army in 1946 with the rank of lieutenant colonel. He returned to Emery Industries at that time taking charge of the plastics section of the research department.

• Peracetic Acid Available

Peracetic acid, although known for a

long time, has been a laboratory item in the past. Concentrated solutions could be made only by laborious preparation of high concentrated hydrogen peroxide which, upon reaction with acetic acid, forms peracetic acid. The large scale production of hydrogen peroxide of 90% concentration by the Buffalo Electro-Chemical Company, Inc. made it possible for that company to devise a commercially useful process for the manufacture of Peracetic Acid. This new oxidizing agent is now available in limited quantities in form of a stable, 40% solution, containing 8.6% active oxygen.

Aliphatic peracids, characterized by the -COOOH group, allow the carrying out of oxidation reactions not possible with other peroxygen compounds of the peroxide type, containing the -OOH group.

Solutions of peracetic acid are said to be efficient bleaching agents for various textiles, for proteins and generally for alkali sensitive materials. They are effective in acid and neutral, as well as in alkaline solution. Bulk and emulsion polymerizations can be carried out using peracetic acid as polymerization catalyst. Bacteria and other micro-organisms are said to be killed rapidly by contact with very dilute solutions of peracetic acid, making this chemical interesting as an efficient sterilizing and disinfecting agent. Enzyme systems are inactivated by peracetic acid solutions. Peracetic acid solutions further are said to permit one to carry out various reactions important in organic synthesis. Hydroxylation or epoxidation of olefinic double bonds is possible in an efficient reaction. Substituted benzene or naphthalene rings undergo splitting by reacting with peracetic acid, e.g. oxidation of phenol to muconic acid or of beta-naphthol to o-carboxycinnamic acid. Sulfides are oxidized to the corresponding sulfones, anthracene to anthraquinone, etc.

The Buffalo Electro-Chemical Company, Inc. is engaged in continuing research to find further uses for this new and promising oxidizing agent.

• Synthetic Textiles Dept., L. T. I.

President Kenneth R. Fox of the Lowell Textile Institute recently announced the creation of a new department of synthetic textiles, with new equipment and personnel, to begin operation this fall. A pilot course in synthetics has been offered for several years, administered by the older departments but the developments in synthetics and the demand for special training has resulted in the new department being set up with its own laboratories and instructors.

Dr. Chapin A. Harris of Plymouth, Massachusetts has been appointed to head the new department with the rank of professor. Dr. Harris received his B.S. degree in chemistry from the University of Michigan in 1936 and his Ph.D. in chemistry from the Massachusetts Institute of Technology in 1939. Since 1939 Dr. Harris has been with the Plymouth Cordage Co. in their research department, which he presently heads. He is an active member of the American Chemical Society, Fiber Society, American Association of Textile Chemists and Colorists and other professional societies.

Jacob K. Frederick, Jr. was appointed Assistant Professor in the new department. He received his B.S. degree in textile engineering from the Rhode Island School of Design in 1941, where he served as student instructor during his last year. He was awarded the Atlantic Rayon fellowship and spent considerable time in the plants of the American Viscose Corp. at Marcus Hook and Parkersburg as well as doing advanced work at M.I.T. Working under the fellowship he secured experience at the Putnam Mills and Atlantic Rayon as well as in retailing merchandising of synthetics.

Following his fellowship he has been employed by Textron, Inc. in Providence and Lowell. He is a member of American Association of Textile Chemists and Colorists, American Association of Textile Technologists, American Chemical Society, American Society for Quality Control, American Society of Testing Materials, and the Textile Research Institute.

• Nopco Coverage Changes

Several changes in territorial coverage have been announced by the Industrial Division of Nopco Chemical Company, Harrison, N. J.

In the Midwest, Frank J. Chadwick, who has been with the company for over 12 years, replaces Edson R. Rice who recently retired. Mr. Chadwick will service the accounts of both Nopco and Metasap Chemical Company throughout Wisconsin, Minnesota and North and South Dakota. The accounts formerly handled by Mr. Chadwick in Manhattan will now be covered by Thomas J. Campbell.

John J. McCloskey, Jr. has been assigned the Long Island, Brooklyn and Queens territory.

• Paraplex RG-10

Paraplex RG-10, an addition to the series of versatile alkyd-type, polymeric plasticizing resins, and intended for use with nitrocellulose, urea and melamine resins, is announced by the Resinous Products & Chemical Company.

Due to its color, durability and flexibility, Paraplex RG-10 is recommended by the manufacturers for use in high quality nitrocellulose coated fabrics, in white lacquer for use on rubber articles and in tough, oil-resistant cable coverings.

Further information about the new material may be obtained by writing the Resinous Products & Chemical Co., Washington Square, Philadelphia 5, Pa.

• Heat Treating Process

A German patented heat treating process for carrying out various chemical reactions on textiles by passing the material through a molten metal bath is described in a report now available from the Office of Technical Services, Department of Commerce. The process is one of many German textile developments described in a comprehensive 222-page report, compiled by Francis S. Richardson for the Office of the Quartermaster General, U. S. Army.

The German patent covering the process, which is translated in the report, states that heat treatment of textile chemical compounds is generally accomplished with heating plates, drying cylinders, heated air, or with heated water vapor. A different method is here proposed wherein the textile material, previously treated with the proper dye, water repellant or crease resistant compounds, travels on guide rollers through a bath of molten lead, tin, or alloys of lead, tin, bismuth or cadmium for a given period of time. The temperature of the treatment may be regulated below or above 100 degrees centigrade depending on the metal or alloy. The metal bath may be heated by firing or, more advantageously, by electric current. Overheating is not a danger because the metal, being a good conductor, does not accumulate heat.

The report also contains German wartime regulations for fabric bleaching.

The report gives a full account of the findings of a textile investigating team sent into Germany by the Research and Development Branch of the Office of the Quartermaster General shortly after the invasion by American troops.

Orders for the report PB-22337 (*Textile Finishing Processes;* photostat, $15.00; microfilm, $2.50; 222 pages, including charts, diagrams, photographs, tables and formulas) should be addressed to the Office of Technical Services, Department of Commerce, Washington 25, D. C., and should be accompanied by check or money order, payable to the Treasurer of the United States.

Mimeographed copies of the report may be obtained from the Hobart Publishing Co., Box 4127, Chevy Chase Branch, Washington 15, D. C., at $12.50 each.

A list of other reports dealing with the German textile industry may be obtained from OTS on request.

• PATENT DIGEST •

PAUL WENGRAF

Vat Dyeing—Indigoid dyes combined with acid dyes, applied on wool C, 4, 03

U. S. Pat. 2,420,729

(Allied Chemical & Dye Corp., Weber, May 20, 1947; application March 30, 1944)

Dyeing of woolen piece goods with indigoid vat dyestuffs presents more difficulties than dyeing cotton or rayon with dyestuffs of the same group. It is of course particularly necessary to avoid too strongly alkaline vats. Weakly alkaline vats, mostly containing ammonia or soda ash, have been generally used, together with protective colloids like glue or casein. Full shades, for instance Navy Blue, are not satisfactory as a rule, regarding their poor fastness to washing or crocking. Moreover creasing or wrinkling has to be avoided because of the tendency of the goods to become uneven. The present invention solves the problem of dyeing wool in dark shades on the winch in the following manner. The goods are dyed in rope form in a vat of an indigoid dyestuff (or of indigo itself) the extent of dyeing being *insufficient to give a full shade.* Thereupon the full color, as desired, is produced by cross dyeing the piece with an acid wool dyestuff. But the acid color may also be applied first and the vat dyestuff in a subsequent operation. Examples are: bottoming with a combination of chrome dyes (for instance Alizarol Azurin ECA, Superchrome Blue BC and B, Superchrome Red ECB and Superchrome Yellow RN, all of Nat. Aniline Div. of All Chem. & Dye Corp.) and topping with indigo in an hydrosulfite-soda ash vat to which glue is added.

References: "Textile Colorist" 1938 p. 240 (Brandenburger) compares in a very detailed article the aspects of dyeing wool with vat dyestuffs with those of chrome dyed wool fabrics. No suggestions are made for combining these both processes. Cross dyeing of acid dyeings on wool fibers with indigoid vat dyes or vice versa has probably not been tried out up to now, although other combinations such as sulfur or direct dyestuffs, top-dyed with basic dyestuffs have very frequently been carried out in former times. A slight analogy might be found in the acetate cellulose dyeing method of Ger. P. 620,-246 (Ciba), recommending to dye first cellulose with vat dyes and to aftertreat the fibers with potassium acetate and acetic anhydride (for performing a superficial acetylation) whereupon these fibers can optionally be cross dyed with different acid dyestuffs.

Vegetable Glue — from Cassava and Wheat Flour G, 1

U. S. Pat. 2,419,160

(Perkins Glue Company, Pierson, April 15, 1947; application October 26, 1943)

Various starches have been used for preparing so-called vegetable glues. A preferred starch is Cassava starch giving quite generally glues of strongly adhesive properties. It has been observed however that these glues have a tacky and rubbery consistency so that they do not smoothly spread over the surfaces to be laminated. Although the present invention might more be concerned with plywood manufacture it could also find some application in combining two or more sheets of textiles. It may briefly be stated that good results in producing adhesives have been obtained by combining Cassava Starch with wheat flour and converting this mixture (ratio about 35-50 per cent wheat flour calculated from the total amount of Cassava Starch) by an alkaline treatment into glue. Small amounts of finely divided calcium compounds have proved to act as liquidifiers and stabilizers during the conversion process. The ratio of water to starch, contained in the finished product may be 2:1 to about 3½:1.

References cited by the Patent Office are amongst others U. S. Pat. 2,372,666 (Stein, Hall): tapioca starch composition, consisting of enzyme converted starch, non gelatinized starch and urea as pasting inhibitor; U. S. Pat. 2,275,845 (Drake): tapioca and other underground starch mixed with 2-30 per cent overground starch for instance corn starch; U. S. Pat. 2,102,937 (Stein, Hall): mixtures of ungelatinized and gelatinized starch prepared by adding small amounts of caustic soda (formed *in situ* from calcium hydroxide and soda ash) and an oxidizing substance.

A special report on Cassava Starch and its uses was printed in Bull. Imp. Inst. 1942 (London S. W. 1) p. 257 and abstracted in Chem. Abstracts 1943 p. 3295.

Cellulose Zincate Solution G, 2, 01

U. S. Pat. 2,419,341

(Edelstein, April 22, 1947; application December 13, 1943)

The cellulose zincate solutions used for producing permanent finishes on vegetable fibers have been described in Edelstein's U. S. Pat. 2,322,427 1943. The product has been known since under the tradename of "Kopan." The present invention has to be considered as a continuation-in part of this former patent. It has been discovered that dissolution of cellulose in zincate is promoted by selecting a fibrous material of a certain maximum particle length. This optimum fiber length is limited with 200 microns and should preferably have a length of 140 microns. The fiber is dissolved in the zincate solution at a relatively low temperature for instance at 0°—min 10° C. It has been found that the result is improved by finally comminuting the fibers. Parts which were initially inside of the fibers are now exposed to the action of the zincate. Rayon, thus a degraded cellulose by itself, cut to a fiber length less than 140 microns, dissolves rapidly in zincate and gives a solution remaining clear for some days. As to the material used in the process the examples name low viscosity cellulose, cellulose ethers, Cellophane waste and the like, therefor mostly regenerated cellulose compounds. It has to be emphasized that the scope of the invention is enlarged thereby that some of the examples suggest to dissolve cellulose in chilled alkalies alone without adding zincate and that this special method is also covered by one of the claims (Nr. 2).

References: see AMERICAN DYESTUFF REPORTER 1946 p. 460, abstract to Ger. P. 749,082. This patent and Ger. P. 750,012 1944 suggest to treat cellulose in very finely subdivided form, preferably after a mild oxidation with a zincate solution. It has to be particularly established that the Ger. P. was published after the application of the present patent only.

Sizing Yarn Packages—Low melting emulsions A, 4, 01

U. S. Pat. 2,419,756

(du Pont, Arnold, April 29, 1947; application Nov. 6, 1943)

In knitting rayon yarns, generally a high twist is required. The sizes applied have to preserve the yarns against mechanical injuries, giving them at the same time a smooth surface thus lubricating the fibers during the entire knitting (or weaving) process. The high twisted yarns have the tendency to kink and to untwist so that sizing has the principal purpose to set the twist. Customary sizes are said to make the sizes either stiff and brittle or

too sticky. The present invention aims to eliminate all these disadvantages by sizing the spun cakes of yarns with a *non-mucilagineous* aqueous sizing composition comprising a soapy or waxy material having a softening point between 30-70°C. Examples for these compositions are, for instance, mixed butylester of stearic acid (48 per cent), behenic acid (48 per cent), and (4 per cent) erucic acid, dispersed in water by using sodium stearate. The rayon cake is soaked in this dispersion, removed and hydroextracted. The dried cake was found to contain about 9 per cent of the solid sizing composition.

References, cited by the Patent Office are amongst others: U. S. Pat. 2,219,728 (North Amer. Rayon): suggesting quite generally to apply aqueous emulsions without previously drying the cakes; U. S. Pat. 2,297,135 (Amer. Viscose): impregnating viscose packages with wax-like esters of poly alcohols with higher fatty acids or with soaps; U. S. Pat. 2,298,432 (Eastman Kodak): butylstearate emulsified with different soaps as lubricating agent.

Other References are: Brit. P. 409,469 (Gamma); rosin-or tallow soap-emulsions for lubricating yarns; U. S. Pat. 1,979,188 (Enka): preparation of yarns with emulsions of mineral oils, ordinary and organic amine soaps.

U. S. Pat. 2,419,783 (Quaker Chemical Products, Longley) issued the same day describes also products for sizing rayons with emulsions of derivatives of lignin-sulfonic acid. The final products were identified as the stearic acid esters of sodium lignin sulfonate, obtained from lignin-sulfonic acid and stearyl chloride.

Polyvinyl Resin Finishes — Dispersions in Rosin Mixtures G, 2, 01

U. S. Pat. 2,419,816

(U. S. Rubber Co., Brown, April 29, 1947; application October 20, 1944)

The present invention states that rubber particles can readily be dispersed in water by milling and using one of the known hydrophilic colloidal dispersing agents such as colloidal clay, solubilized casein, soap or the like. A similar method cannot generally be carried out with synthetic resins because they do not readily absorb soap and similar emulsifying agents. A new method has now been found for incorporating synthetic resins in aqueous dispersions. Use is made of a reaction product of rosin, an alkanolamine and a *dimerized acid of a drying oil.* These reaction products by themselves have been described in another application of the same inventor, apparently not yet published. Under "dimerized acid" the combination of two molecules of an unsaturated acid has been understood. These two molecules combine by addition polymerization. Polyesters are formed which are said to be of a complex nature. Such a polyester is for instance the reaction product of a dimerized acid derived from soy bean oil with diethylene glycol, known under the tradename "Norepol." This polyester, a triethanolamine and a rosin (or abietic acid) are mixed and heated until a reaction occurs. A dark gel-like resin is obtained which is suitable for dispersing artificial resins, principally those of the polyvinyl type.

References concerning earlier work done in this field: U. S. Pat. 2,370,057 (Advance Solvents) Poly-isobutylene-rosin-polymers and methylcellulose are described as finishing emulsions. U. S. Pat. 2,351,912 (Hercules Powder): rosin soaps are used as emulsifying agents in general. Brit. P. 481,206 (I. G. Farbenind.): arylic acid polymers + rosins used for sizes of the emulsion type.

Flameproofing Fabrics — Silica-enamel composition G, 2, 03

U. S. Pat. 2,420,644

(Pemco Corp., Athy, Stufft, May 20, 1947; application June 16, 1942)

Flameproofing compositions described in this patent consist of three main components: a metal (lead), a refractory constituent (quartz) and a fluxing agent (borax). A typical example is a lead-boro-silicate glass composed of following ingredients:

17.6% Pb O
6.1% B_2O_3
16.3% SiO_2

This enamel is produced by melting the single components in a furnace and the characteristic of the thus obtained product is a melting point beteen 700-1500° F. The melted product is removed from th furnace, granulated or otherwise ground to small particles which are mixed with a flameproofing vehicle, for instance chlorinated paraffin, chlorinated rubber and the like. A volatile solvent (carbon tetrachloride or coal tar naphtha) and a plasticizer might be used. Other substances, known in the fireproofing technique, for instance Sb_2O_3 may also be added. Therefor the characteristic feature of this invention is the application of a relatively low melting enamel, covering the ignited fabric with a fire-resistant surface layer.

Reference: an old fireproofing composition (Brit. Pat. 402,422, Rodwell) consisted of silica gel and latex but the present method uses a flameproofing vehicle (chloroparaffin) instead of the latex.

References cited by the patent office are among others: U. S. Pat. 2,118,787 (Hooper & Sons): describes a painting composition consisting of 20-55 per cent highly chlorinated paraffin oils, an inorganic salt for instance borate and different other ingredients; U. S. Pat. 2,044,-176 (Westinghouse El.): a non-inflammable paint, containing Antimony oxide and chlorinated rubber; U. S. Pat. 1,896,042 and 040 (Vega Manufact.): insulating wires with a flexible resin. A preliminary coat is given here by fusing Antimony oxide before applying the proper coating mixture. Brit. P. 570,884 (Moon et al.): a flameproofing composition consists of sodium silicate, chica clay and acids.

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WANTED—Chemist; Ph.D. with practical experience in textile field for employment in laboratory located in the South doing development work connected with Southern textile manufacturing and finishing plant. Please give all information in first letter including education, experience, age, whether married and expected salary. Write Box 291.

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WANTED: SALES MANAGER, to direct sales of complete perfected line of chemical specialities, synthetic resins, adhesive, detergents, coatings, finishes for textile processing and allied fields. Technical Director Ph.D., with 12 years' supervisory experience in Research Production, seeks to be associated with salesman with proven sales record, to expand present limited facilities. Capital investment considered. Write Box 298.

WANTED: Young man in New York City, preferably with dyestuffs experience for textile printing research work and ultimately for sales and service to textile printers. Applications should state qualifications and salary expected. Write Box 299.

POSITION WANTED: Textile Colorist with good knowledge of dyeing and printing on all types of fabrics desires position with a progressive dyestuff concern in or near the Metropolitan area. Write Box 300.

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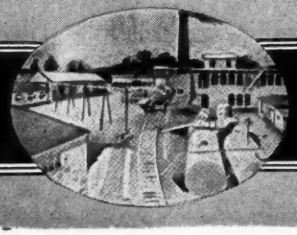

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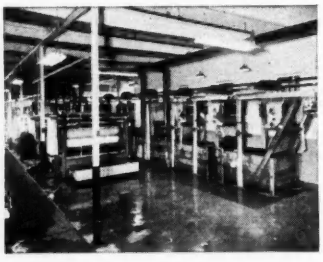

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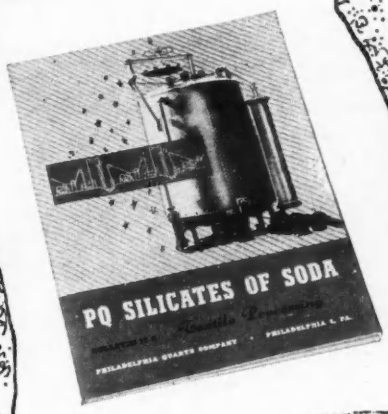

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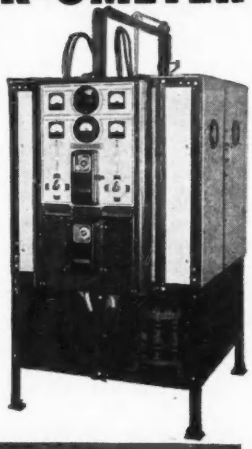

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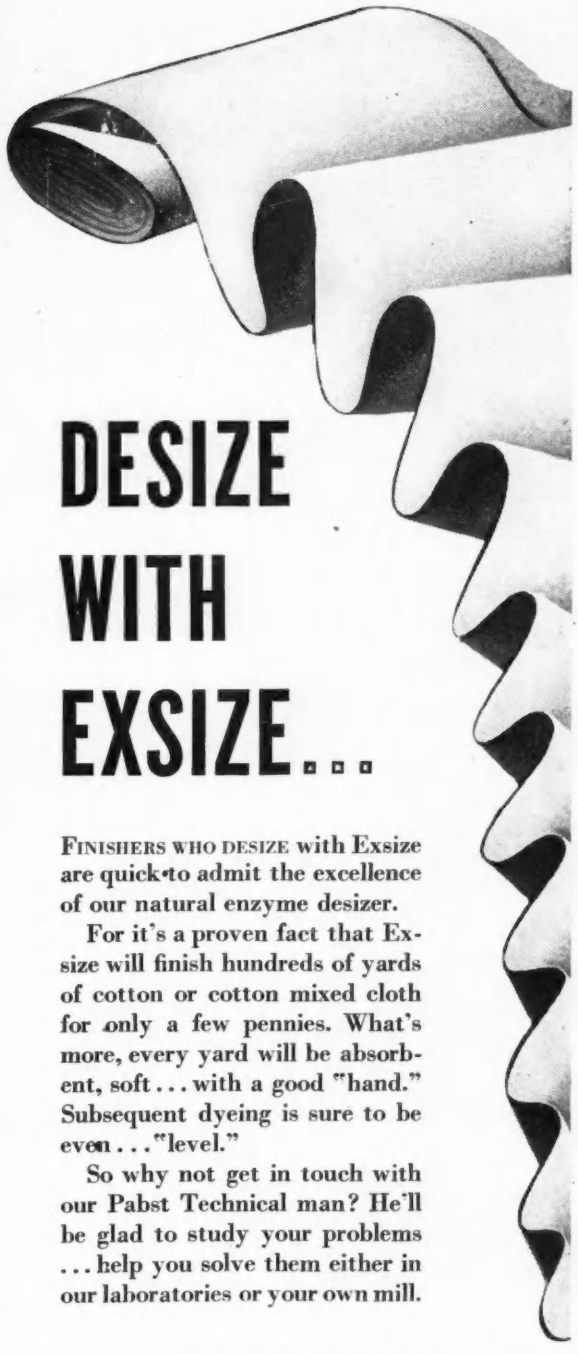

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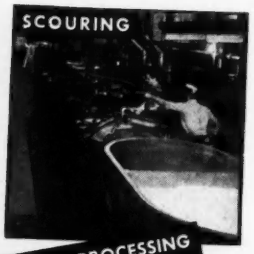

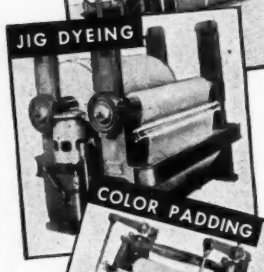

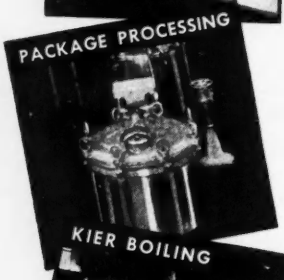

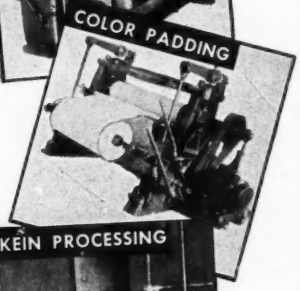

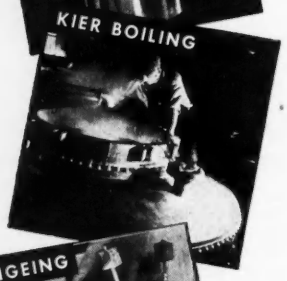

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